FLIGHT

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CONTENTS

DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

1931

- **Nov. 27.** No. 70 Sqdn. R.A.F. Reunion Dinner at R.A.F. Club.
- **Nov. 27.** Southport Ae.C. Dance.
- **Nov. 28.** Opening of New Clubhouse of Lancashire Ae.C., at Woodford.
- **Nov. 30.** "Diesel Engines," Lecture by H. R. Ricardo, before R.S. Arts.
- **Dec. 3.** "Wheel Brakes and Undercarriages," Lecture by S. Scott Hall, before R.Ae.S.
- **Dec. 3.** Boxing: Lord Wakefield Competition, Henlow Camp.
- **Dec. 4.** R.A.F. Dinner, Martlesham Heath.
- **Dec. 4.** London Ae.C. Annual Dinner and Dance, at Park Lane Hotel.
- **Dec. 4.** Hampshire Ae.C. Ball at Portsmouth.
- **Dec. 4.** No. 3 Sqdn. R.A.F. Reunion Dinner, at Mayfair Hotel, W.
- **Dec. 4.** A.I.D. Northern Office Dinner at Sheffield.
- **Dec. 4.** Yorks Ae.C. Annual Ball.
- **Dec. 7.** "Diesel Engines," Lecture by H. R. Ricardo, before R.S. Arts.
- **Dec. 9.** R. Ae.C. Schneider Banquet at Claridge's.
- **Dec. 10.** "Air Flow—Demonstrations on the Screen by Means of Smoke," Lecture by W. S. Farren, before R.Ae.S.
- **Dec. 11.** Rugby: R.A.F. Final Trial, at Uxbridge.
- **Dec. 12.** First Reunion Dinner of Comrades of the R.A. Forces.
- **Dec. 17.** "Control Beyond the Stall," Lecture by Dr. G. V. Lachmann, before R.Ae.S.

1932

- **Jan. 14.** "Interference," Lecture by E. Ower, before R.Ae.S.
- **Jan. 15.** D.H. Technical School Dance at Portman Rooms, W.
- **Jan. 28.** "Effect of Height on Range," Lecture by A. E. Woodward-Nutt and Flt.-Lt. A. F. C. Scroggs, before R.Ae.S.
- **Feb. 13.** Rugby: R.N. *v.* R.A.F., at Twickenham.
- **Feb. 24.** "A Flight to Abyssinia," Lecture by Sqdn.-Ldr. J. L. Vachell, before R.U.S.I.
- **Mar. 10.** "Results with the New Wind Tunnel at N.P.L.," Lecture by E. F. Relf, before R.Ae.S.
- **Mar. 16.** "Development of Naval Air Work," Lecture by Commodore N. F. Laurence, before R.U.S.I.
- **Mar. 23.** "High-Speed Flying," Lecture by Sqd.-Ldr. A. H. Orlebar, before R.U.S.I.

EDITORIAL COMMENT

THE Royal Air Force is a very young service. It accumulated a great deal of experience during the war, but matters have advanced so rapidly in the 13 years since the signing of the Armistice that its war experience is now of only limited utility. The merging of the Royal Flying Corps with the Royal Naval Air Service towards the end of the war had the effect of throwing all previously accumulated experience into the one melting pot.

Schools of Thought

The Armistice found the new service with something very like a clean slate, and the opportunity to make a fresh start in thinking out theories for its future policy. The technical advance in the performance of aircraft which has been going on ever since has stimulated service thought. Designers have shown ability to progress in one direction or another, and the Royal Air Force has had to make up its mind as to what sort of progress will best suit its needs. That different schools of thought on various problems have been formed is a proof of the vitality of the service. Did all officers think alike on any one of the vital problems of the moment, we should be inclined to suspect that service flying cramped the intellect and produced a body of men something like a flock of sheep, all dumbly following the bell wether. The energy with which divergent opinions are held and advanced proves that thought is active among the officers of the Royal Air Force.

Naturally the Air Staff holds an official opinion. Naturally also, that opinion must tend to vary with changes in the personnel which compose the staff. The members of that staff are not youngsters, but at the same time the staff itself is young. It cannot be prone to hold with crusted tradition; for tradition has not yet had time to grow crusted. The Air Staff must have the suppleness of mind of a youthful body, and that is all to the good. At the same time it must, of necessity, lack experience. If war experience is largely ruled out of court, there is no experience to which the Air Staff can appeal, except to the results of air exercises, which are still very experimental in character, and are quite as artificial as is all sham fighting. Almost each new product of

the aircraft designers brings a new set of problems before the Air Staff, which must be studied without the help of any experience.

Mr. Winston Churchill's latest war revelations have raised a point which it is germane to consider. He alleges that in dealing with the U boat campaign the senior Admirals held views which were proved by subsequent experience to be quite wrong ; while a number of junior officers held views which proved to be the salvation of the country. But, he goes on to assert, the traditions of the Navy made it very difficult for the country to take advantage of the sound views of the junior officers. It is very much to be hoped that the Royal Air Force will never develop such a tradition as that. Where all are, from the service point of view, young, it is doubly necessary that the junior officers should have ample opportunity to express their views. Discussions in service journals are very helpful, and so are the lectures delivered at the Royal United Service Institution. Discipline and respect for senior officers must, of course, be observed in the manner in which opinions are set forth, but questions of policy ought to be frankly discussed in both those ways.

To take a case in point, last week a paper was read before the Royal United Service Institution by Wing Com. R. M. Bayley, D.F.C., on "Flying Boats in Empire Defence." Wing Com. Bayley is on the staff of the Deputy Director of Organisation at the Air Ministry, and so presumably voiced the official views of the Air Staff as at present constituted. He has graduated at the R.A.F. Staff College, and he has had practical experience of flying boats at Basra. His opinions, whether they are the official views of the Air Staff or not, must therefore be heard with attention. That is not to say that they need be accepted as Gospel.

There are two schools of thought in the service as regards the lines upon which flying boats should be developed. One holds that performance in the air ought to take precedence ; the other holds that performance when on the water and when landing and taking off should receive the first attention of designers. Again some think high cruising speed the first essential of performance in the air, while others hold that range is more important than speed. Wing Com. Bayley expressed very definite views on these subjects. He defined a flying boat for R.A.F. purposes as not a ship with wings but an aircraft which uses the sea as an aerodrome. He added that an ocean-going flying boat was not in sight at present. It may be noted that the first of these definite statements sounds like an emphatic contradiction of the old slogan of the Supermarine firm, which was "not an aircraft which floats, but a boat which flies." We admit that that dictum was formulated in the days of single-engined boats, or at least in days when continuing flight with one engine out of action had not become a practical proposition. We admit that the multi-engined boat reduces the risk of forced landings, and therefore, if only forced landings are considered, reduces the degree of seaworthiness which is required in a boat when compared with its aerodynamic qualities. In other words, if you never have to alight on a rough sea, it does not very much matter if your boat is not highly seaworthy. It becomes better to make it a good flying machine.

Wing Com. Bayley, however, seemed to give his case away a few sentences later, when he said that it was useful for a flying boat on patrol to be able to come down on the sea and wait. There were occasions when tactics made it advisable for it so to wait resting on the sea. In that case it seems to us that a high degree of seaworthiness is of supreme importance. The argument of having a reserve engine does not apply when a deliberate landing is made. Flying boats will be of very restricted use if they cannot live through a normally rough sea off the British coasts. We must say that we agree with the school of thought which holds that the first desideratum in a flying boat is that it should be able to survive. We admit the truth of the old war dictum that you cannot make an omelette without breaking eggs. In war, risks must be taken and casualties must be expected. But none the less we hold that a boat which becomes a loss whenever it has to alight in a rough sea is a very useless weapon of war. It is not only the loss of the personnel and of the boat which matters. The wreckage may carry most important results of a valuable reconnaissance to the locker of Davy Jones.

On the question of range, Wing Com. Bayley held that this was a desideratum for boats stationed overseas, which may be asked at any time to reinforce small Empire outposts a considerable distance away. For work in Home waters he considered high cruising speed more important than long range ; and he thought that for about the same expenditure two boats of moderate size would be more useful than one large boat. Those views seem sound, so long as the degree of seaworthiness which we mentioned above is not sacrificed for the sake of speed and cheapness. Overseas stations may need communication with Home. If this link is not to be dependent on the permission of foreign nations, then we must have a supply of boats which are able to fly non-stop from England to Gibraltar, and on from Gibraltar to Malta. Wing Com. Bayley attempted to discount this argument, first by mentioning that one R.A.F. boat (*i.e.*, the "Saro A7") has already flown non-stop from Gibraltar to England, and secondly by asking why a belligerent flying boat should not be allowed to refuel at a neutral port, as that concession was allowed to belligerent warships by the international rules of war. No details of the flight of the "Saro A7" have been published, and so it is not possible for us to express an opinion as to whether this was a "freak" flight with an overload, or whether it proved that the boat in question could repeat its performance regularly in any normal weather.

In the meantime, we do not consider that the school which puts air performance far above water performance has proved its case ; but the distinction made between fast boats for service in Home waters and long-range boats for service overseas is distinctly interesting. Now we should like to hear the other school of thought given an opportunity to state its views. Who can tell, the service being as young as it is, and aircraft being constantly improved in performance, that the official views of to-day may not be regarded as out-worn heresies to-morrow?

The R.A.F. West African Flight

EL OBEID: The first station in the Sudan province of Darfur after turning westwards from Khartum. (*Crown Copyright Photo.*)

We have during the last few weeks recorded briefly the progress of the Royal Air Force 1931 flight to West Africa. It appears, however, that sufficient attention has not been paid to the admirable practice of the Middle East Command of the Royal Air Force in sending a flight to the British East African colonies every year. The first flight some years ago was made to Kano, in Northern Nigeria. It was very significant, because previously the colonies in West Africa had looked on the sea as the only means of communication with the rest of the British Empire. By the sea they could communicate with either South Africa or with Gibraltar and Great Britain. Communication with East Africa must have seemed to them a mere dream. Certainly no East-West communication by rail is possible, and we feel equally certain that there are no adequate roads. Between the British possessions and protectorates in East and West Africa there was a great gulf fixed—a gulf of desert and forest. This gulf has now been spanned by the aeroplane.

To reach Northern Nigeria was much. This achievement did not, however, set a limit to our ambition. Last year No. 47 (Bomber) Squadron pushed its flight through to Bathurst, the capital of the little colony of Gambia, and so actually reached the Atlantic Ocean. A photograph of Gambia is seen below. For the present year a still more ambitious flight was planned, which was intended to visit not only Northern Nigeria and Gambia, but also Accra, the capital and seaport of the

BATHURST: The capital of Gambia Colony, situated on the Atlantic Ocean. This city was visited by the R.A.F. Flight of 1930, but the flight of this year had to turn back without reaching it. (*Crown Copyright Photo.*)

KANO: The chief city of Northern Nigeria. It is a trading centre for a populous district and has an aerodrome (seen in the middle distance) and a racecourse. (*Crown Copyright Photo.*)

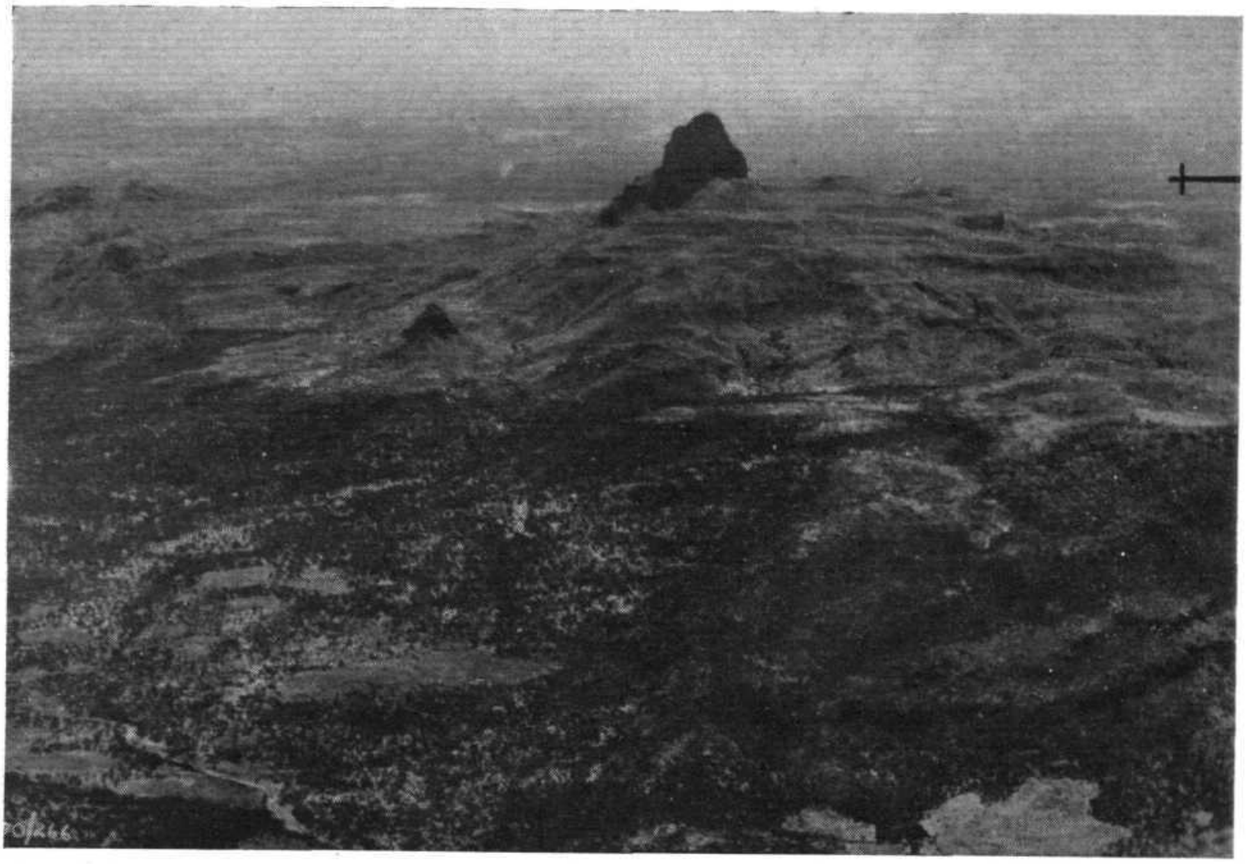
Gold Coast, and Freetown, the capital and seaport of Sierra Leone, thus establishing air communication with all the four West African colonies. The attempt was not successful. The flight was stopped, not by any failure of the aircraft (we have learnt not to expect failures from Fairey III F.'s and Napier "Lions"), but by an outbreak of yellow fever in the French colonies through which the flight would have to pass. The flight reached the Niger River, in French territory, and from there was obliged reluctantly to turn back to the Sudan.

We have no doubt that in coming years the object of sending a flight from Egypt or the Sudan to visit all the four West African colonies will be accomplished. This year we must take the will for the deed; but the idea behind this flight was so great, so Imperial and so strategic, that the attempt calls for some particular notice. We are obliged to the courtesy of the Air Ministry for permission to publish some air photographs taken on the 1930 flight, which give a good idea of the country over which the aircraft have to fly. For descriptions of the towns visited we have drawn on an account of the 1930 flight, which was written by Sqd. Ldr. Howard-Williams, M.C., and published in the October issue of the "Royal Air Force Quarterly"—a publication of which any service might be proud.

The flight this year was entrusted to No. 45 (Bomber) Squadron, which is stationed at Helwan. Four Fairey III F. aircraft, with Napier "Lion" engines, were despatched on the flight. Sqd. Ldr. Francis J. Vincent, D.F.C., himself took command of the flight. Air Commodore R. Peel Ross, D.S.O., A.F.C., accompanied the flight as representative of the Middle East Command. The personnel of the flight was as follows:—Sqd. Ldr. Vincent, Flt. Lt. H. E. Walker, M.C., D.F.C., F/O. A. R. Combe, and four airmen selected from among Flt. Sergt. Johnson, Sgt. Pitcher, Sgt. Kemsley, and acting Sgts. Tibbles and Jones.

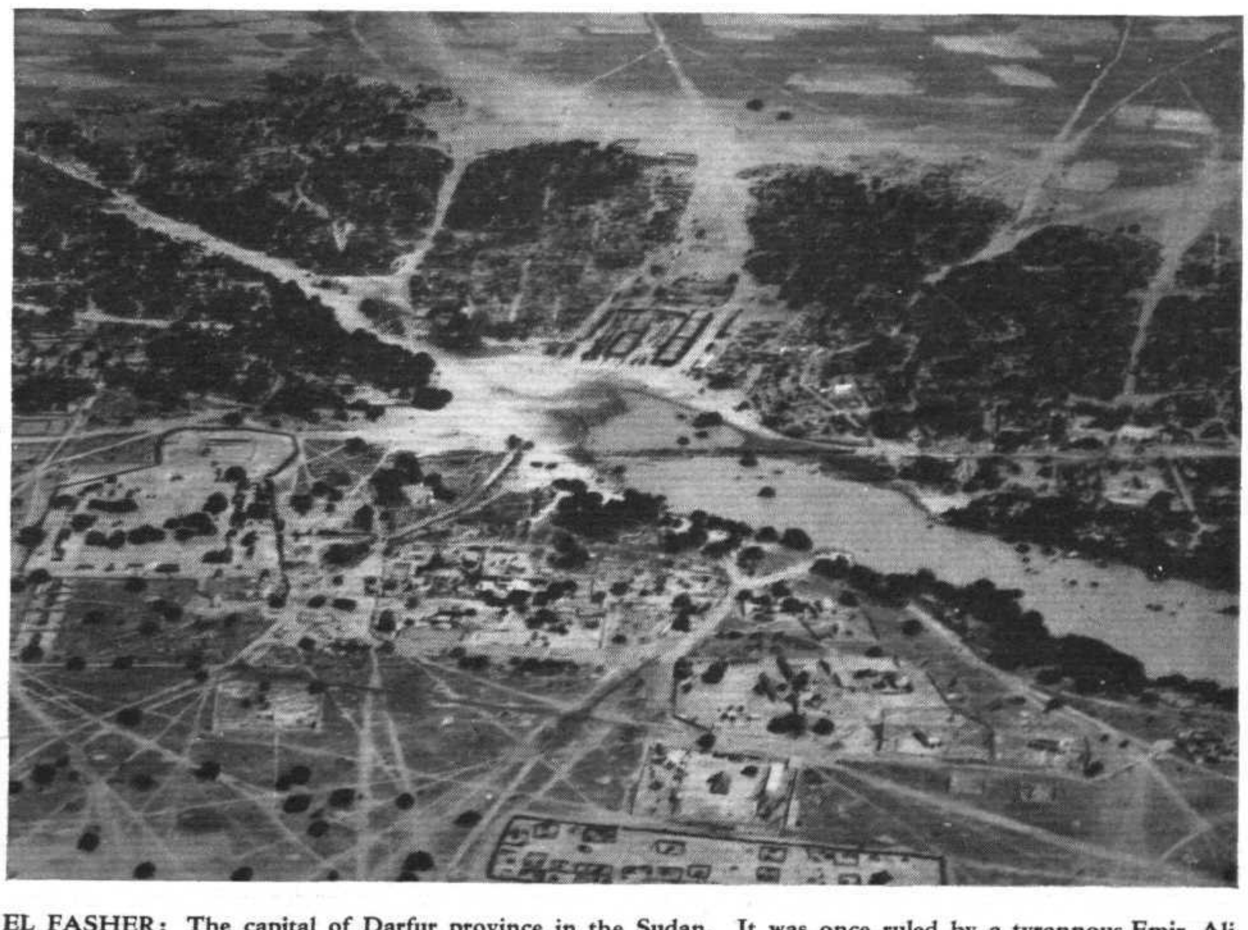
The flight left Helwan on October 15, proceeding up the Nile in the ordinary way through Assiut and Wadi Halfa to Khartum. The scene of Gordon's great defence marks the three cross-roads of the air. On the 18th the flight turned right-handed from Khartum and headed off to the West across the desert. El Obeid is the first place passed, and then comes a stop at El Fasher. This place is the capital of the Sudanese province of Darfur. The country flown over is sandy desert, with a good deal of low scrub. During the great war the Emir of Darfur, Ali Dinar, a tyrannous ruler, thought to take advantage of our many commitments, and so to defy us. A British expedition from the Sudan quickly undeceived him, and a brilliant little campaign ended in our taking the whole of Darfur directly under British control. The market at El Fasher has been built since British control became a reality, and is an interesting centre of trade for local leather work, etc. Our readers will doubtless be interested in the air pictures of El Obeid and El Fasher.

On October 20 the flight proceeded to Geneina, on the border of French territory. West of El Fasher the country is more rugged, with low hills and watercourses, which are dry except in the rainy season. Next day the flight flew over French territory, of course by previous arrangement, and, led part of the way by roads, they arrived at Ati. The next town on the way is Fort Lamy. At both Ati and Fort Lamy the flight of 1930 experienced most lavish hospitality from the French, and doubtless the men of No. 45 B.S. were no less fortunate. Then the border was



JEBEL BARA SIMBAL: An impressive rock of curious formation seen by the R.A.F. Flight. This picture gives a good idea of some of the country over which the machines flew. (*Crown Copyright Photo.*)

crossed into Northern Nigeria, and the flight once again had British territory below their wheels. The first Nigerian town to be met is Maidugari, which is shown in another of our photographs. The leader of the 1930 flight says that as they reached Maidugari they met "the pageantry and dignity that belong to the northern half of Nigeria." Large crowds had been waiting since dawn to see them, and they were bewildered at the reception they received on landing. Something like 20,000 Bornu people were assembled in their fine clothes, a large number



EL FASHER: The capital of Darfur province in the Sudan. It was once ruled by a tyrannous Emir, Ali Dinar, whom we subdued in 1916. (*Crown Copyright Photo.*)

of horsemen carrying tom-toms. The Sheikh of Bornu and his Council were grouped in a tent bedecked with gay colours and rich carpets, while the British people were in a second tent near by. The Bornu people seem to be very wealthy compared to other people in West Africa; but they are unspoiled by civilisation. It is the custom for them to salute a British person by sitting on their haunches, with their heads bowed to the ground. We once delivered the Sheikh of Bornu from a tyrannous overlord, and he and his people are grateful.

The next stop was Kano, which was reached on October 23. A track which can be used by cars in the dry weather leads through the jungle from Maidugari to Kano, and this is followed by aeroplanes also. Kano was the terminus of the first flight to West Africa, and the aerodrome there is now well established. It can be seen clearly in the photograph which we reproduce. Kano is the most important town in Northern Nigeria, and there, too, a great welcome always awaits the annual flight of R.A.F. aircraft. It is, for the natives at least, and probably for the Europeans, too, the great event of the year. The flight spent a week there: Probably there was some overhauling to be done, and there were certainly many dinners to be eaten. No doubt sport of some sort was enjoyed, perhaps polo, perhaps shooting, or both. The Emir of Kano rules a population of some 3,000,000 souls.

On November 1 the flight proceeded to Katsina, in the extreme north-west of Kano province, and right on the border of French territory. The Emir of Katsina gained his present dignified position by his business enterprise. Sqd. Ldr. Howard-Williams tells the story as follows. "Many years ago a company of soldiers was ambushed at Sokoto, and was told to retire on Katsina. Two days out the company was ordered back, and arrived at Sokoto to find that the barracks had been looted and partly destroyed. The commander decided that another fort was essential. He called together the Emir and the chiefs, only to be told that they did not think they could get enough men, nor could they build the fort within a reasonable time. After this council was over a third and rather junior sheikh came in to say that he would promise six thousand men and would build the fort in five days, on the condition that he and his men should be allowed to live inside for fear of reprisals. He carried out his promise, and later became the Emir of Katsina."

MAIDUGARI: A town in Northern Nigeria where the annual flight of the R.A.F. is always given a great reception. The natives of this part are very prosperous and their bright clothes and their horse-drummers make a brave show.
(*Crown Copyright Photo.*)

On November 3 the flight left Katsina for Sokoto, capital city of a district of the same name, which is the most north-westerly district in Nigeria. There all the ambitious plans of this expedition had to be altered. It was while the flight was at Kano that bad news was received from the Governor General of Senegal at Dakar, reporting that the flight would be unable to land at Ouagadougou, in the province of Upper Volta, owing to a recent outbreak of yellow fever. Air Commodore Peel Ross at once informed the Air Ministry of this. The route planned had been from Sokoto to Niamey, Ouagadougou, then south through Tamule to Accra, in Gold Coast; then back to Ouagadougou, and through Bamako and Kankan to Freetown; then north to Tamba Counda and down to Bathurst in Gambia. He applied to the French authorities for permission to follow an alternative route through Gao, Timbuctu, and Segou. This would have meant a very long detour to the north, but that would have been well worth while if it had been possible to get through to Gambia and Sierra Leone. Presumably the Gold Coast was now out of the question in any case, as Ouagadougou was the junction aerodrome from which the flight was to have turned south for Accra. The question about this Timbuctu route was whether sufficient petrol and oil would be available along it, and these doubts proved to have been well founded. While at Sokoto it was definitely ascertained that fuel was not available on the alternative route, and so, with the greatest reluctance, the Air Commodore had to decide to cancel the flight. He knew that the people in the other three colonies would be grievously disappointed, and the great demonstration of linking up all the colonies by air must be left for a future occasion. None the less, from Sokoto three of the four Faireys flew on to Niamey up the Niger River, in French territory. Possibly this was a personal visit by the Air Commodore to a French Governor, and the question of fuel may have been finally discussed with him. The three machines then returned to Sokoto, and on November 6 the whole four flew back to Kano. On the 8th they reached Maidugari, on the 11th Fort Lamy and Ati, on the 12th Geneina, on the 14th El Fasher, and on the 15th El Obeid and Khartum. From there the route back down the Nile is so well known that no further reference to it is necessary. From the technical flying point of view, this flight can be accounted a success. No. 45 (Bomber) Squadron may be congratulated on their feat, and so may the Fairey and Napier firms for their share in it. Next year we look forward to hearing that the full programme of visiting Nigeria, Gold Coast, Sierra Leone, and Gambia has been successfully carried out.

FOREIGN INTEREST IN THE AUTOGIRO: A small French mission recently visited England to study the Cierva machines. Here some of its members are seen with representatives of the Cierva company. From left to right: P. Cour, G. Prat, L. Bourdin, J. de la Cierva, G. Lepere, and A. H. Rawson. (Flight *Photo.*)

French Impression of the Autogiro

M. LUCIEN BOURDIN, chief test pilot of the French Dewoitine firm, during a visit to this country to study the Cierva Autogiro, made a flight in one of these machines. He gives his impressions of this flight in a letter to Mr. de la Cierva, of which the following is a translation.

"Until now my opinion of the Autogiro was simply that it was a funny looking machine, and I personally had no desire to find myself hanging in the air under rotating blades. Since you have allowed me to fly your machine my opinion has entirely changed. I find it is exceedingly pleasant to fly this new aircraft, and the landing is still more so, especially when one understands what an enormous amount of room is necessary to land an ordinary aeroplane and what a great degree of skill is required, while it is just child's-play with the Autogiro. To touch the ground without any bump and with a run of less than 3 ft. is really very pleasant, but the quality that interests me most in the Autogiro is its stability during slow descent.

"I was at about **7,000** ft. altitude, and was amusing myself by coming down vertically, facing wind, just above the aerodrome, when I noticed directly under myself an enormous cloud, which I would have immediately avoided had I been flying an aeroplane. I asked myself 'What happens if one enters a cloud with the Autogiro in vertical descent?' I kept my machine gliding always dead slow, the engine absolutely throttled back, the air speed indicator showing less than **30** m.p.h., and the altimeter showing **5,000** ft. I entered the cloud and felt one or two slight bumps, and then that awful 'pea-soup' surrounded me. My air speed indicator still showed less than **30** m.p.h.; my altimeter dropped with splendid regularity. I did not move the controls in the least and I felt absolutely, perfectly happy.

"After five minutes I still saw no sign of the earth; my altimeter showed about **600** ft., and I asked myself, 'Where am I going to find myself and in what position?' The 'pea-soup' evaporated and thoroughly disappeared, and the ground became visible again; the machine was on a perfectly even keel; my air-speed indicator still showed less than **30** m.p.h. I had made absolutely no movement at all. Where was I? Still facing the same direction, but about half a mile to the back of the point over which I had started my descent. I had in all probability descended backwards in relation to the ground, since I was facing the wind. What a great confidence in flying the Autogiro to know that you can fly with the greatest facility and without the slightest risk through clouds or fog at a vertical speed of **12** ft. per sec., much slower than in a parachute. This is what I most appreciate in the Autogiro and what makes me love it."

C.24. AUTOGIRO DEMONSTRATION AT HANWORTH

LAST week we were able to illustrate and describe the two new types of Autogiro which the Cierva Company now has stationed at Hanworth, and it was mentioned that a demonstration of these was to take place on Thursday last. The demonstration was duly given, although it had to be confined to one of the types only, the C.24 cabin machine with de Havilland Gipsy III engine. The other machine, the C.19 Mark IV, with Armstrong Siddeley "Genet Major" engine, had not yet received its Certificate of Airworthiness, and so, according to A.M. regulations, could not be "demonstrated," although there was, of course, nothing to prevent Mr. de la Cierva from taking it up for a "test flight," which he did repeatedly.

Capt. Rawson, the Cierva Autogiro Company's chief test pilot, who has been responsible for a large share of the firm's experimental test work, demonstrated the C.24 right effectively, while later Mr. Brie obliged with flights in the older C.19 with biplane tail and four-bladed rotor, which provided an interesting comparison with the newer types.

The writer of these notes had the opportunity to go up with Capt. Rawson in the C.24, and perhaps a few impressions of the flight may be of interest. The starting of the rotor by means of the new engine drive and clutch was

effected without difficulty of any kind and in a very short time. Disengaging the clutch and wheel brakes were simultaneous operations, and after an incredibly short run the machine was in the air. Its rate of climb after the short run was not spectacular, and would doubtless have been better had Capt. Rawson held the machine on the ground a little longer.

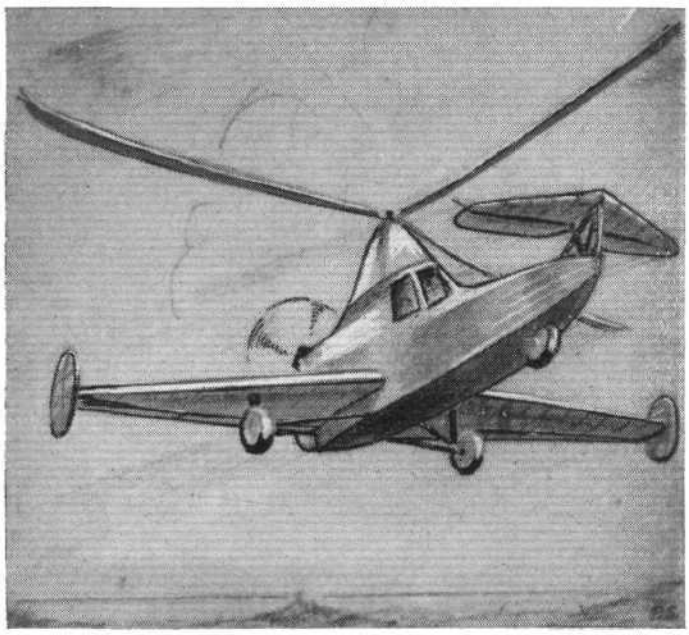
Once in the air and "into its stride" the C.24 felt very much like a normal aircraft. It was not until Capt. Rawson pulled the stick back and put the rudder hard on that any great difference was noticed. Then one had a vivid impression of the peculiar qualities of the Autogiro. The manœuvre would have put a normal aircraft into a spin. The Autogiro merely did a sharp turn, almost around its own axis, and at practically no ground speed. Once the peculiar sensation had become familiar one had a remarkable feeling of safety.

The writer is not a pilot, but Capt. Rawson insisted on him taking control (at a good safe altitude, of course!). The machine was ridiculously easy to fly. It is sensitive, certainly. The smallest movement of the control stick, either in a fore and aft or lateral direction, produced results; more especially, perhaps, was the elevator control sensitive, or so it appeared to a non-pilot. The rudder control is also sensitive, but even one totally inexperienced in the practice of flying had no difficulty in keeping a straight course. To make turns is remarkably easy. The stick can be held central and the rudder kicked over, when the machine automatically takes up its proper bank for the turn.

But far and away the most fascinating characteristic of the Autogiro was found to be its slow-flying ability. With the air-speed indicator showing less than 30 m.p.h. one floated along over the hedges and fields. There was time to have a good look around before going on again, and the performance brought home to one a very important feature of the Autogiro which is, perhaps, apt to be overlooked, or at least to be imperfectly appreciated. We refer to this ability to float around at almost no speed. On a day of bad visibility, what a comfort it must be to know that if one gets into weather conditions which are really hopeless one has time to look around. One can, so to speak, put the brake on while one thinks things over. It is not at all certain that this is not as great an advantage as the Autogiro's ability to land with no run. Aero engines are getting very reliable these days, and the risk of a forced landing with a "dead" engine is not nearly as great as it was seven or eight years ago. In the very remote event of such a landing having to be made, the occupants of the Autogiro have a good chance of making such a landing in safety.

Thoughts such as these come invariably to anyone flying in an Autogiro. The landing (made, *entendu*, by Capt. Rawson and not by the writer) was of the "no-roll" variety. It was certainly a little disturbing to a "tail-downer" to find the machine pitch forward on to its front wheel, the resilience of which is such as to make one doubt if the pitching is going to stop in time. However, it does, and one is down close to one's destination instead of having to taxi across half the aerodrome to it. On a windy day one applies the brake to the rotor blades, and they soon slow down to a speed at which there is no longer any risk of overturning.

As for the C. 24 itself, regarded purely as an ordinary aircraft, one or two minor modifications will probably have to be made. At present the cabin is a little cramped. It is no use denying it. And windows in the roof, particularly towards the rear, would be welcome. For quietness and general comfort (the cramping apart) the cabin is of about average characteristics. The noise, if it is no less, is certainly no greater than in any other machine. A separate door for the passenger would be welcome, but may be less essential if the cabin is made a few inches wider.



WILL IT COME TO THIS?: A FLIGHT Artist's conception of the result of combining three types which seek to avoid stalling and spinning; the Autogiro, the "Ente" and the Pterodactyl. The name might be something short and snappy, like "Pteroautogirentedactyl."

A Pilot's Impressions of the Autogiro

THE new cabin Autogiro Type C.24 is considerably simpler to fly than the preceding types. The actual flying while in the air would seem to be entirely automatic and to require even less thought than the normal type of aircraft. The view is excellent and the controls comfortably arranged. Starting the rotor is simple, and once one has learnt the sequence of the necessary operations presents no difficulty at all. Taxying is comparatively straightforward, although we imagine that, as in other aircraft, considerable care would have to be exercised when taxying across wind. Running up the rotor at present makes a good deal of noise, and might be likely, we feel, to frighten timid passengers, but no doubt subsequent rotor drives will be made considerably less noisy. As this running up takes some appreciable time, during which the aircraft is on the aerodrome ready to take off, the provision of a rearward view would seem advisable in order that the pilot might assure himself that no other aircraft was preparing to land, just as he himself, was about to take off. The three-blade rotor appears to be smoother than the older four-blade type, and the machine in general feels livelier. Landing is of course a simple matter, and with a little care the machine may be brought down almost vertically, the new undercarriage appearing perfectly able to deal with a descent of this type.

A "Pusher" Autogiro

THE Autogiro Company of America writes to inform us that the first test flights of a new Autogiro, built by the Buhl Aircraft Company of Detroit, are scheduled to take place during the present month, and that Senor de la Cierva will be leaving in a few weeks to witness flights and attend conferences with American Autogiro engineers. The new Buhl machine will, it is stated, be of the pusher type, and will, it is hoped, combine the exclusive Autogiro features of performance with the good view and absence of draught and noise which characterised the pusher aircraft of the earliest days of flying.

Air Map for Winter Flying in Canada

OF interest to aviation companies and to aviators generally is a small map of Canada recently issued by the Topographical Survey of the Department of the Interior giving the average date of the start and end of the flying season for float and boat planes. With the increasing use of the plane in Canada, and particularly in the northern parts of the country, such information becomes a matter of importance. The limiting dates for half-monthly intervals are shown by a series of red and blue lines; the red lines indicating the approximate average date in spring when the ice disappears from small waterways and small bays of large waterways, other than tidal bays, and the blue lines the approximate average date in fall when the ice appears thereon. The information used in the preparation of this map covered some 500 stations and was obtained from various sources including the Topographical Survey itself, the Meteorological Service of Canada, the Civil Government Air Operations, the Hudson's Bay Co., the Pilots of the British Admiralty, the U.S. Weather Bureau, and others.

Private Flying & Club News

FILMS AT HANWORTH.—On Saturday evening last, November 21, at Hanworth Club, two very interesting films were shown for the benefit of the members. The first one was a German one called "The City of To-morrow." This film was one which has been exhibited by the London Society at the Royal Society of Arts, and comprised two parts. The first showed the haphazard growth of many existing cities, while the second showed the German conception of the growth of a well-planned city. Both were illustrated with scenes showing the contrast in amenities which a well-planned city and a haphazard one could offer, and particular stress was laid upon the provision of gardens and open spaces suitable for children's playgrounds. Both films took the form of an aerial view during the period of growth, and showed, in the first place, houses and factories springing up in all directions, and, in the second place, on well ordered lines. Personally we feel that a city with all the streets in straight lines must of necessity lose a great deal of its charm and would be incompatible with English tradition, but at the same time there would seem to be no reason why adequate provision should not be made for the retention of an adequate number of open spaces, without losing something of the charm of our present haphazard growth.

AVIATION AT BROOKLANDS.—This week's flying was opened by a formation flight by three Brooklands instructors on three school machines, to signify "Business as Usual." Sales and repairs departments are both busy, the former having just sold four machines. On the school side, Mr. Richards and Miss Meakin are new additions, joining for their "A" licences with a possible "B." Lady Chaytor is the most thorough of pupils who joined this week however, for, while working for her "A" and "B" licences, she is spending as much time as possible in the aircraft and engine shops.

AERIAL BEAGLE MEET.—The Northants Aero Club held their third annual Aerial Beagle Meet on Saturday, November 21, when Mr. Noël Lloyd and his Pipewell Beagles met at Sywell Aerodrome. As it was a glorious day, many flying visitors came to enjoy the fun, and a few indulged in some unusual and strenuous exercise. There were many hares, but the scent was not too good; however, it was all good sport, and the going was very good, even the ploughland did not seem so heavy as usual. In the evening there was a cheery dinner and dance at the Salon, which was followed in the early and moonlight hours of Sunday morning by a bacon and egg party at Sywell. Everything in the moonlight seemed beautiful, and consequently most people were—to put it mildly—surprised to awake some seven hours later to a fogbound world. There was never a chance of flying away, so by late afternoon most of the visiting pilots had departed for their various destinations by train or car, leaving Sywell the richer by a trio of "Avians" and one Comper "Swift." Among the visitors by air were:—3-seater "Spartan," Col. and Mrs. Strange; "Moths," Messrs. Beale, Browne and Whittome; "Avians," Messrs. Bentley, Brett and Taylor; Comper "Swift," Flt. Lt. N. Comper.

THE COVENTRY AERO CLUB, which was inaugurated a few months ago, is making good headway. The draft rules, modelled on the lines of the Lancashire Aero Club, have been adopted, and the club will now be registered as a private company.

The name of Mr. J. D. Siddeley has been added to the list of vice-presidents, and the club has been greatly assisted by the offer of facilities for the use of the Whitley Aerodrome of Armstrong-Whitworth Aircraft, Ltd

LEICESTERSHIRE AERO CLUB.—The Leicestershire Aero Club is holding its Annual Ball on March 4, 1932, at the King's Hall, Leicester; tickets £1 1s. each, from the Hon. Sec., Desford Aerodrome, Leicester.

EASTERN COUNTIES AEROPLANE CLUB.—A successful dance, organised by the Eastern Counties Aeroplane Club, was held at the Red Lion Hotel, Colchester, on November 20, and was attended by nearly 200 members and friends. This was the first dance of its kind ever held in Colchester, and the ballroom was suitably decorated with aero propellers and the new civil ensign. The music was provided by the New Wana Dance Orchestra. Owing to the fog several parties were unable to reach Colchester, but in spite of the weather the function proved most enjoyable.

THE "CUTTY SARK" AT SINGAPORE: As mentioned on this page, the Singapore Flying Club is using a Saro "Cutty Sark"—loaned by the Straits Settlements Government—for advanced training. In the accompanying view the machine has the appearance of being "flood-lighted"—but the answer is in the negative!

SINGAPORE FLYING CLUB.—The Singapore Flying Club's Saro "Cutty Sark" (2 Hermes) flying-boat, which has been assembled for some time awaiting the completion of insurance arrangements, completed its flying tests recently. The machine is to be used for advanced training. Flt. Lt. S. H. Potter piloted the machine through its tests. The machine will stand up to seas to which it is unwise to subject the Club's three existing "Moth"

THE HANWORTH CLUB.—A Dance (from 9 p.m. to 2 a.m.) will be held at the Hanworth Club on Friday, November 27. Temple's Band will supply the music, and M. Georges Seversky (of Quaglino's) will sing. Tickets, dinner and dance 7s. 6d., dance only 5s., from the Sec., The London Air Park, Feltham, Middlesex.

The Royal Aero Club's Address

In view of the fact that the Royal Aero Club for some weeks now have removed to their new premises at 119, Piccadilly, we need hardly point out that the old address, 3, Clifford Street, was inserted in the official notices last week in error.

FLYING BOATS IN EMPIRE DEFENCE

WING COMMANDER R. M. BAYLEY, D.F.C., delivered a lecture on "Flying Boats in Empire Defence" before the Royal United Service Institution on Wednesday, November 18. The chair was taken by Air Vice-Marshal R. H. Clark-Hall, C.M.G., D.S.O.

The lecturer defined a flying boat as an aircraft which uses the sea as an aerodrome, but not a ship with wings. He said that an ocean-going flying boat was not in sight at present. The development of flying boats had been slow, partially because their problems were more complex than those of other aircraft. The limit of size was reached later in the case of a flying boat than in the case of a landplane, and, theoretically, the flying boat could stand more overload. The landplane was tied more or less to fixed routes. The flying boat was not so tied. It needed little laying out of a route beyond supplies of fuel and oil, which could be put ready for it in some creek. Moorings were desirable, but not essential.

Speaking of seaworthiness, the lecturer said that this was divided into two parts, the ability to manœuvre in rough water, and the ability to take off in rough water. He considered a breaking sea with waves five feet high a rough sea. A flying boat could use the open sea for resting on during a patrol. This was an asset. It was convenient at times to come down and wait. A high degree of seaworthiness increased the value of a flying boat. But seaworthiness entailed a low landing speed, and therefore a low speed in taking off. A flying boat should have a high cruising speed.

The lecturer then mentioned the three types of flying boats used in the Royal Air Force. The "Southampton" had been a very successful boat, and had many good qualities, but now it was looked on as slow. The "Iris" was a larger and faster boat, but suffered from an exaggerated V in the hull section. The "Rangoon" was a good boat, but its cruising speed was on the slow side. He alluded to the flight from Gibraltar to England non-stop of the Saro A.7, but did not mention the type of boat.

The lecturer mentioned the ideal of having one type of very versatile boat, but said that it would be very expensive. He considered that the rôle of flying boats at home and overseas was different. Functions varied with locality. Long range was not so essential for a boat operating in home waters, but was very desirable for boats stationed overseas. For home work he considered that two small boats would be better than one large one, and the cost would be about the same.

Flying boats, he said, could act for a long time from an improvised base. The use of a surface ship as a base was wasteful, and the surface ship was slow. Bases can be simple, and he foresaw that they will be multiplied throughout the Empire. There were some routes in the Empire which were only practicable for a flying boat. He instanced the case of a political agent at Bushire wanting to visit a political agent at Muscat. By the old methods of travel, the former would be absent 19 days. Now that flying boats were available, he would only be absent five days.

Turning to the qualities of the flying boat, the lecturer said that the facilities for navigation were good. The vulnerability of a boat had been overrated. A modern boat had four machine guns with a good arc of fire. Holes in the hull could be repaired and did not mean that the boat would sink when she landed. He considered that, if properly fought, a single flying boat would be a tough proposition for a single-seater fighter. He strongly disputed the view that a boat would have to fly low to escape a fighter, and particularly so if there were two or three boats in company. The risk of forced landings was always reduced in multi-engined aircraft. Therefore, boats were capable of flying across land.

In time of war the lecturer saw lots of work for flying boats in the narrow seas and along the coasts. They could guard straits, and, when necessary, summon other craft to reinforce. In defence of a harbour, one of their principal functions would be to prevent surprise. If flying boats patrolled out to sea for 200 miles each evening, it should be impossible for a hostile fleet to make a surprise attack on the port at dawn.

In Empire defence the lecturer said that we could not afford to provide adequate defences all over the Empire. In many cases we could only provide deterrents to an attack. Then flying boats would be very useful in reinforcing. On the outbreak of war he thought that our flying-boat squadrons would be most busy, because the flying boat was the most versatile form of aircraft.

The lecturer asked why a belligerent flying boat should not be allowed to refuel at a neutral port, as surface ships were. Also, he asked why they should not fly over neutral territory when only employed on reinforcement duty. He personally believed that in a future war the enemy would use aircraft for an unrestricted attack on shipping. We Britons would not start such action, as we stood to lose most from it, but we ought to be prepared to make reprisals.

The following table of performances of service flying boats was printed on the précis paper which accompanied the lecture:—

PARTICULARS OF EXISTING SERVICE FLYING BOATS

Dimensions and Weights

Type.	Engines.	Span. ft.	Length. ft.	All-up Weight. lb.
Southampton ..	2 Napier "Lion" ..	75	48	15,500
Iris	3 Rolls-Royce "Condor"	97	68	30,000
Rangoon ..	3 Bristol "Jupiter"	93	66	24,000

Ranges, Speeds and Bomb-loads

Type	Petrol	Bombs	Endurance.	Speed	Range. (a) Theoretical. (b) Practical	Cruising Speed	Remarks. All calculations are made on fuel consumption at full speed of aircraft (approx.).
	galls.	lb.	hr.	m.p.h.	miles	m.p.h.	
Southampton	500	Nil	7·0	104	(a) 725 (b) 580	80	—
	370	1,000	5·0	104	(a) 517 (b) 410	—	
Iris ..	1,000	Nil	6·9	118	(a) 815 (b) 652	97	Normal load; no bombs.
	1,500	Nil	10·6	118	(a) 1,250 (b) 1,000		Maximum overload take-off at this load doubtful except under favourable conditions.
	740	2,000	4·9	118	(a) 588 (b) 470		Normal load with bombs.
	1,240	2,000	8·6	118	(a) 1,025 (b) 820		Maximum overload with bombs (see above).
Rangoon	680	Nil	5·6	112	(a) 630 (b) 504	92 to 95	Normal load without bombs.
	550	1,000	4·4	112	(a) 499 (b) 400		Normal load with bombs.
	1,130	Nil	9·6	112	(a) 1,084 (b) 867		Overload without bombs.
	1,000	1,000	8·5	112	(a) 953 (b) 760		Overload with bombs.

NOTE.—Theoretical range is worked out assuming ideal conditions; practical range assumes average conditions.

About Diesel Engines

MR. H. R. RICARDO delivered the first of the Howard Lectures before the Royal Society of Arts on Monday, November 23, at 8 p.m. He had a most enthusiastic audience and the Hall was full to overflowing. This being the first of the series, the lecture was confined to the elementary principles of the Diesel engine and a dissertation on the manner in which it operates. By way of illustrating more graphically what actually takes place in the cylinder of such an engine, Mr. Ricardo asked his audience to imagine that they were sitting on the top of a piston in a cylinder, and he then proceeded to describe his conception of what they would see and feel from the time the fuel valve opened until the power stroke was finished. Mr. Ricardo's powers of description were so vivid that we were tempted, somewhat irreverently, to feel that he was wasted as an engineer. The next of this series of lectures will take place on November 30.

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

November 27, 1931

CONTENTS

WING OSCILLATION

By A. E. PARKER, B.Sc.

(CASE I)

IN this case only the spars will be considered, and the effect of the bracing will be entirely omitted, except as regards the weight of the wing.

As a wing warps, the centre of pressure of the wing moves backward or forward, depending on the direction of warp. In Fig. (1) the end view of a section of a wing is shown. If L is the load per foot run at this section

Then :—Load on front spar $= L\left(\frac{a + d - c_p}{d}\right)$

Load on rear spar $= L\left(\frac{c_p - a}{d}\right)$

The significance of the symbols is obvious from the figure. θ is the angle of incidence of the wing after warping. Sin $\theta = \frac{\mu_1 - \mu_2}{d}$ and if θ is small $\theta = \frac{\mu_1 - \mu_2}{d}$ approximately.

If a graph of load on the spars as ordinates, and θ as abscissæ, is plotted, a straight line for each spar will be obtained.

Hence the load on front spar at velocity v will be $\{a_1\,\theta + b_1\}\,\frac{w}{g}\,v^2\,c\,dx$ for a strip dx wide, where c is the chord. Put $\frac{w}{g} = \sigma =$ air density.

Considering fig. (2), at a distance x from the fuselage, the forces acting are: the elastic force of the fuselage, the wind force, and the gravitational force.

$$\therefore\ E.I_1\,\frac{\delta^4\mu_1}{\delta\,x^4}\,dx - (a_1\,\theta + b_1)\,\sigma\,v^2\,c\,dx = \frac{-\,\delta^2\mu_1}{\delta\,t^2}\,\frac{\omega}{g}$$

where w is the weight of the wing per foot run (unit) g is the acceleration due to gravity.

$$\therefore\quad \frac{E.I_1}{w}\,g\,\frac{\delta^4\mu_1}{x^4} + \frac{\delta^1\mu_1}{\delta\,t^2} = (a_1\,\theta + b_1)\,\frac{\sigma\,g\,v^2\,c}{w}$$

$$\frac{E.I_1}{w}\,g\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t^2} = \left\{g_1\left(\frac{\mu_1 - \mu_2}{d}\right) + b_1\right\}\frac{\sigma\,g\,v^2\,c}{w}$$

$$\frac{E\,I_1}{w}\,g\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t^2} = \frac{a_1\sigma\,g\,v^2c}{w\,d}(\mu_1 - \mu_2) + \frac{b_1\sigma\,g\,v^2c}{w}$$

$$i.e.,\quad P_1\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t^2} = Q_1\,(\mu_1 - \mu_2) + R_1.$$

A similar equation will be obtained for the rear spar. Hence the equations of motion are :—

$$(1)\ \ldots\ P_1\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t^2} = Q_1\,(\mu_1 - \mu_2) + R_1\ \ldots \text{ for front spar}$$

and

$$(2)\ \ldots\ P_2\,\frac{\delta^4\mu_2}{\delta\,x^4} + \frac{\delta^2\mu_2}{\delta\,t^2} = Q_2\,(\mu_1 - \mu^2) + R_2\ \ldots \text{ for rear spar.}$$

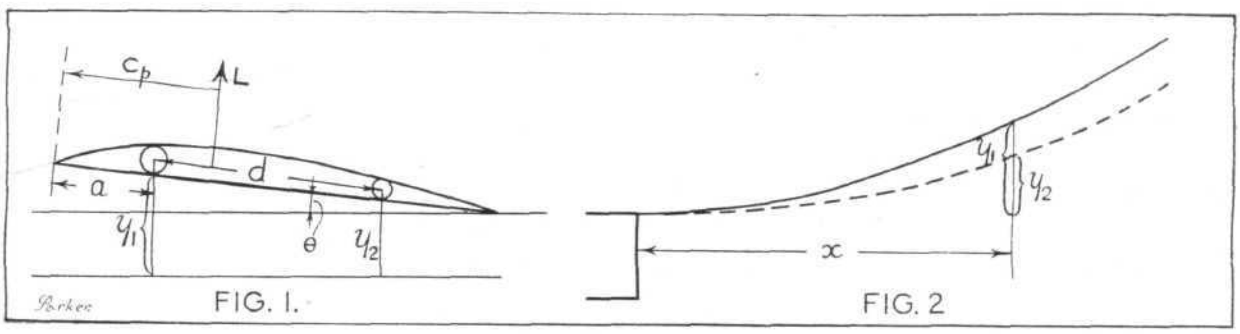


FIG. 1. FIG. 2

Case I.

Now $\mu_2 = \dfrac{Q_2\,\mu_1 - R_2}{(P_2\dfrac{\delta^4}{dx^4} + \dfrac{\delta^2}{\delta\,t^2} + Q_2)}$ Substitute in (1)

$$P_1\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t} = Q_1\mu_1 - \frac{Q_1\,Q_2 - Q_1\,R_2}{(P_2\,\dfrac{\delta^4}{\delta\,x^4} + \dfrac{\delta^2}{\delta\,t^2} + Q_2} - R_1$$

$$\therefore \left(P_1\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^2\mu_1}{\delta\,t^2} - Q_1\mu_1 + R_1\right)\left(P_2\,\frac{\delta^4}{\delta\,x^4} + \frac{\delta^2}{\delta\,t^2} + Q_2\right) = -\,Q_1Q_2\mu_1 + Q_1R_2$$

$$\therefore P_1P_2\,\frac{\delta^8\mu_1}{\delta\,x^8} + P_1\,\frac{\delta^6\mu_1}{\delta\,x^4\delta\,t^2} + P_1Q_2\,\frac{\delta^4\mu_1}{\delta\,x^4} + P_2\,\frac{\delta^6\mu_1}{\delta\,x^4\,\delta\,t^2} + \frac{\delta^4\mu_1}{\delta\,t^4} + Q_2\,\frac{\delta^2\mu_1}{\delta\,t^2} - P_2Q_1\,\frac{\delta^4\mu_1}{\delta\,x^4} - Q_1\frac{\delta^2\mu_1}{\delta\,t^2}\Big\} = R_1Q_2$$

$$\therefore P_1P_2\,\frac{\delta^8\mu_1}{\delta\,x^8} + (P_1 + P_2)\,\frac{\delta^6\mu_1}{\delta\,x^4\delta\,t^2} + (P_1Q_2 - P_2Q_1)\,\frac{\delta^4\mu_1}{\delta\,x^4} + \frac{\delta^4\mu_1}{\delta\,t^4} + (Q_2 - Q_1)\,\frac{\delta^2\mu_1}{\delta\,t^2} = Q_1R_2 - Q_2R_1$$

Put $\mu_1 = \mu_a + \mu^1{}_1$

$$\therefore P_1P_2\frac{\delta^8}{\delta x^8}\,(\mu_a + \mu_1{}^1) + (P_1 + Q_2)\,\frac{\delta^6}{\delta x^4\delta t^2}\,(\mu_a + \mu_1{}^1) + (P_1Q_2 - P_2Q_1)\,\frac{\delta^4}{\delta x^4}\,(\mu_a + \mu_1{}^1) + \frac{\delta^4}{\delta t^4}\,(\mu_a + \mu_1{}^1) + (Q_2 - Q_1)\,\frac{\delta^2(\mu_a + \mu_1{}^1)}{\delta t^2} = Q_1R_2 - Q_2R_1$$

Now, μ_a is the displacement of the wing when there is no oscillation, hence :—

$$P_1P_2\,\frac{\delta^8\mu_1{}^1}{\delta x^8} + (P_1 + P_2)\,\frac{\delta^6\mu_1{}^1}{\delta x^4\delta t^2} + (P_1Q_2 - P_2Q_1)\,\frac{\delta^4\mu_1{}^1}{\delta x^4} + \frac{\delta^4\mu_1{}^1}{\delta t^4} + (P_2 - Q_1)\,\frac{\delta^2\mu_1{}^1}{\delta t^2} = 0.$$

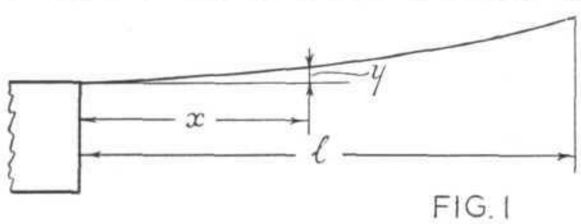


FIG. 1

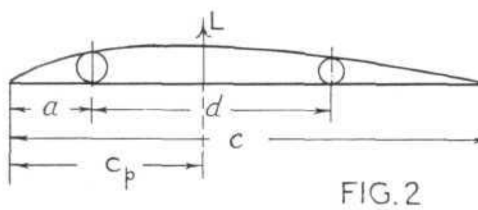


FIG. 2

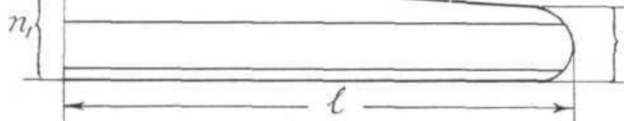


FIG. 3

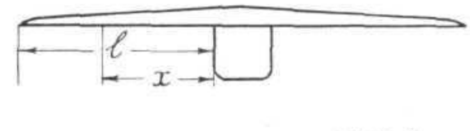


FIG. 5

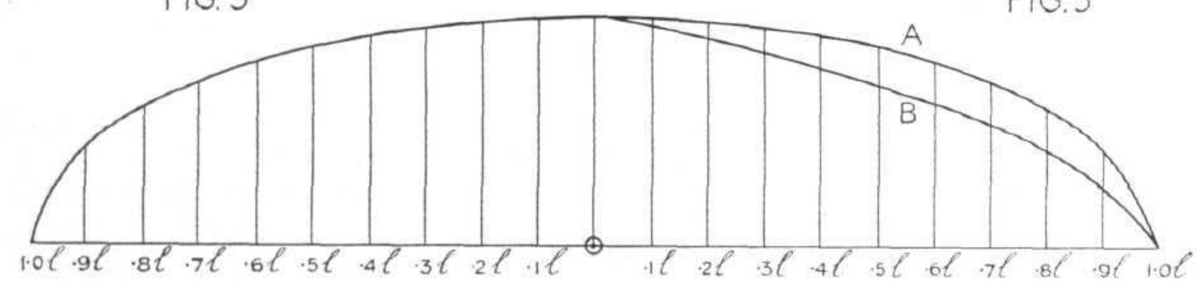


FIG. 4

Case II.

The obvious solution of this is $\mu_1{}^1 = f(x)\cos(nt + \varepsilon)$.

$$\therefore P_1P_2\,\frac{\delta^8 f}{\delta x^8}(\cos nt + \varepsilon) + (P_1 + P_2)\,\frac{\delta^4 f n^2}{\delta x^4}\,\{-\cos(nt + \varepsilon)\} + (P_1Q_2 - P_2Q_1)\frac{\delta^4 f}{\delta x^4}\cos(nt + \varepsilon) + f(x)n^4\cos(nt + \varepsilon) = 0.$$

That is,

$$P_1P_2\,\frac{\delta^8 f}{\delta x^8} - (P_1 + P_2)\,n^2\,\frac{\delta^4 f}{\delta x^4} + (P_1Q_2 - P_2Q_1)\,\frac{d^4 f}{\delta x^4} + n^4 f = 0.$$

$$\therefore \{P_1P_2\,\frac{\delta^8}{\delta x^8} - (P_1 + P_2 - P_1Q_2 + P_2Q_1)\frac{\delta^4}{\delta x^4} + n^4\}\,f = 0.$$

Put $f = Ae^{\lambda x}$.

$$\therefore \{P_1P_2A\lambda^8e^{\lambda x} - (P_1 + P_2 - P_1Q_2 + P_2Q_1)\,A\lambda^4e^{\lambda x} + n^4\,Ae^{\lambda x}\} = 0.$$

i.e., $P_1P_2\lambda^8 - (P_1 + P_2 - P_1Q_2 + P_2Q_1)\lambda^4 + n^4 = 0.$

This is a quadratic for λ^4, from which all the values of λ may be obtained.

What is wanted is the value of n, and this depends on the arbitrary constants obtained in the final solution. Further in this theory the wings have been assumed rectangular, and the load per unit run constant, which is, obviously, very far from the truth. In the next case the loading on the wings will not be considered constant along the span, and tapered wings will be used.

(Case II)

In this case an elliptic distribution of pressure over the span will be assumed, and this will be modified due to the tapering of the wings. The centre section of the wings will be assumed to have no lift, *i.e.*, the portion immediately above the cabin. Curve A, Fig. 4, shows an elliptic distribution of pressure. If w is the load at distance x from the root of the wing,

then for an ellipse

$$\frac{w^2}{p_c{}^2} + \frac{x^2}{l^2} = 1$$

$$\therefore \frac{w^2}{p_c{}^2} = 1 - \frac{x^2}{l^2} \qquad \therefore w = p_c\sqrt{1 - \frac{x^2}{l^2}}$$

where p_c is the load at the root of the wing and l is the span from the root of one wing, as shown in Fig. (5).

Now, referring to Fig. 3, if c is the chord at distance x from the root of the wing, then

$$c = \eta_1 - \left(\frac{\eta_1 - \eta_2}{l}\right)x = \eta_1 - mx, \text{ say}$$

where η_1 is the chord at the root of the wing and η_2 is the chord at the tip, if the tips were not rounded. For monoplanes this is not a drastic assumption. It would be better

to take η_2 as the chord of the wing where the spars end. The loading will now be

$$w = p_c\left(\sqrt{1 - \frac{x^2}{l^2}}\right)\left(1 - \frac{m}{\eta_1}x\right).$$

This curve is the curve B, Fig. 4. It will be seen that the tapering has considerably reduced the B.M. on the span of the wing.

As before, if w is the load at any particular section of the wing,

$$\text{Then load on front spar} = w\left(\frac{a + d - C_p}{d}\right)$$

$$\text{load on rear spar} = w\left(\frac{C_p - a}{d}\right)$$

Now C_p is the distance of the centre of pressure from the leading edge, and is therefore a fraction of the chord, *i.e.*, $\frac{1}{3}$.

$$\therefore \text{ load on front spar} = w\left\{\frac{a + d - \frac{1}{3}(\eta_1 - mx)}{d}\right\} = w(\alpha + \beta x)$$

$$\text{where } \alpha = \frac{a + d - \frac{1}{3}\eta_1}{d} \text{ and } \beta = \frac{\frac{1}{3}m}{d}$$

hence the equation of motion of the front spar is :—

$$\text{E.I.}_1\frac{\delta^4\mu}{\delta x^4} - p_c\left(\sqrt{1 - \frac{x^2}{l^2}}\right)\left(1 - \frac{m}{\eta_1}x\right)(\alpha + \beta x) = -\rho\frac{w}{g}\frac{\delta^2\mu_1}{\delta f^2}$$

where ρ is the density of the material of the spar and w the area of cross section. Put $I_1 = wk^2$, where h_1 is the radius of gyration of the cross section of the spar.

$$\therefore \quad Ew_1 k_1^2\frac{\delta^4\mu_1}{\delta x^4} - p_c\left(\sqrt{1 - \frac{x^2}{l^2}}\right)\left(1 - \frac{m}{\eta_1}x\right)(\alpha + \beta x) = -\frac{\rho w}{g}\frac{\delta^2\mu_1}{\delta t^2}$$

$$\therefore \quad \frac{Eg}{\rho}k_1^2\frac{\delta^4\mu_1}{\delta x^4} - \frac{gp_c}{\rho w}\sqrt{1 - \frac{x^2}{l^2}}\left(1 - \frac{m}{\eta_1}x\right)(\alpha + \beta x) = -\frac{\delta^2\mu_1}{\delta t^2}$$

$$\therefore \quad \frac{Egk^2_1}{\rho}\frac{\delta^4\mu_1}{\delta x^4} - \frac{gp_c}{\rho w}\sqrt{1 - \frac{x^2}{l^2}}\left(1 - \frac{m}{\eta_1}x\right)(\alpha + \beta x) + \frac{\delta^2\mu_1}{\delta t^2} = 0$$

or in the most convenient form

$$\frac{Egk^2_1}{\rho}\frac{\delta^4\mu_1}{\delta x^4} + \frac{\delta^2\mu_1}{\delta t^2} = \frac{gp_c}{\rho w}\left(\sqrt{1 - \frac{x^2}{l^2}}\right)\left(1 - \frac{m}{\eta_1}x\right)(\alpha + \beta x) \quad (1)$$

As before put $\mu_1 = \mu_a + \mu^1_1$

Then (1) reduces to

$$\frac{Egk_1^2}{\rho}\frac{\delta^4\mu^1_1}{\delta x^4} + \frac{\delta^2\mu^1_1}{\delta t^2} = 0$$

The solution of the equation is :—

$$*\mu^1_1 = (A\cosh mx + \beta\sinh mx + C\cos x + D\sin x)\cos(nt + \varepsilon) \text{ where } m^4 = \frac{n^2\rho}{k^2Eg}$$

It is an advantage at this point to take the origin at the centre of the bar. This does not affect what has gone previously but is only altering the terminal conditions.

The terminal conditions are at the clamped end :—

$$\mu^1 = 0 \quad \frac{\delta\mu^1}{\delta x} = 0 \quad [x = -\tfrac{1}{2}l]$$

$$\text{and } \frac{\delta^2\mu^1}{\delta x^2} = 0 \quad \frac{\delta^3\mu^1}{\delta x^3} = 0 \quad [x = \tfrac{1}{2}l] \text{ at the free end.}$$

In one class of oscillation

$$\mu^1 = A\cosh mx + D\sin mx$$

with the conditions

$$\left.\begin{aligned} A\cosh\tfrac{1}{2}ml \mp D\sin\tfrac{1}{2}ml &= 0 \\ -A\sinh\tfrac{1}{2}ml + D\cos\tfrac{1}{2}ml &= 0 \end{aligned}\right\}$$

whence $\coth\frac{1}{2}ml = \tan\frac{1}{2}ml$

This is solved by the intersection of the curves $\mu^1 = \tan x$, $\mu^1 = \coth x$ by actually plotting the curves. The latter has $\mu = 1$ as an asymptote. Hence approximately :—

$$\tfrac{1}{2}ml = (S + \tfrac{1}{4})\pi + \alpha^1_\delta$$

where $S = 1, 2, 3$ and α^1 is small. Hence :—

$$\tan\alpha^1_\delta = \xi_\delta e^{-2a1\delta}$$

where $\xi_\delta = e^{-2\delta\pi - \frac{1}{2}\pi}$

whence $\alpha_\delta^1 = \xi_\delta e^{2a1\delta} - \frac{1}{3}\xi^3_\delta e^{-6a1\delta} + \ldots$

which can be solved by successive approximation except when $\delta = 0$ for which special methods are required. In the remaining type of vibrations

$$\mu^1 = \beta\sinh mx + C\cos mx$$

$$\text{with } \left.\begin{aligned} -\beta\sinh\tfrac{1}{2}ml + C\cos\tfrac{1}{2}ml &= 0 \\ \beta\cosh\tfrac{1}{2}ml + C\sin\tfrac{1}{2}ml &= 0 \end{aligned}\right\}$$

hence $\coth\frac{1}{2}ml = -\tan\frac{1}{2}ml$.

The intersection of the curves $\mu = \tan x$ and $\mu = -\coth x$ give the solution of this condition.

The roots are given by

$$\tfrac{1}{2}ml = (s - \tfrac{1}{4})\pi - \beta s^1$$

where $s = 1, 2, 3 \ldots$ Hence

$$\tan\beta^1_s = \xi e^{2\beta_s^1}$$

$$\text{where } \quad \xi_\delta = e^{-2\delta\pi + \frac{1}{2}\pi}$$

Then $\quad \beta_s^1 = \xi_\delta e^{2\beta_s^1} - \frac{1}{3}\xi_s^3 e^{6\beta_s^1} + \ldots$

The frequencies of the whole series of normal modes of vibration after the first are proportional to $3^2, 5^2, 7^2$ — as found experimentally by Chladni. The accurate solution given to five places.

$$\frac{ml}{\pi} = \cdot 59686,\ 1\cdot 49418,\ 2\cdot 50025$$

$$\text{now} \qquad m^4 = \frac{n^2\rho}{k^2Eg}$$

$$\therefore \quad n^2 = \frac{m^4h^2Eg}{\rho} = \frac{(ml)^4h^2Eg}{\rho l^4}$$

$$\therefore \quad n^2 = \frac{\pi^4h^2Eg}{\rho l^4} \times (0\cdot 59686)^4$$

$$\therefore \quad n = \frac{\pi^2}{l^2}k \times (0\cdot 59686)^2\sqrt{\frac{Eg}{\rho}}$$

where n is the frequency.

If we take the airscrew as making 2,000 revs. per min., *i.e.*, 33·3 per sec., then the period of vibration of the wings must not be close to this, otherwise a resonance effect will be produced. It will of course be damped by the fabric and bracing, but even then the amplitude may become too large for safety. In this theory the oscillations have been considered so small that there is no movement of the centre of pressure. This would tend to increase the amplitude of the vibration. Also it appears that if the spars have the same period of vibration, but differ in phase, the front spar being in front of the rear spar, as the spars are rising there will be an increased lift, and while falling a decreased, causing wing flutter.

The whole question of an aeroplane wing oscillating is so complicated that the foregoing theory may not be of much practical use, but it is at least a good applied mathematical study.

The actual value of p_c the load per unit run at the root of the spar or wing can be found as follows :—

$$2\int_0^l p_c\left(\sqrt{1 - \frac{x^2}{l^2}}\right)\left(1 - \frac{m}{\eta_1}x\right) = \text{total lift of wings.}$$

The above integral can be very easily found by putting $x = l$ since then $dx = l\cos\theta\, da$

$$\therefore \quad 2p_c\int_0^{\frac{\pi}{2}} l\cos^2\theta\left(1 - \frac{m}{\eta_1}l\sin\theta\right)d\theta = \text{total lift of wings}$$

$$\therefore \quad p_c = \tfrac{1}{2}\frac{\text{total lift}}{\displaystyle\int_0^{\frac{\pi}{2}} l\cos^2\theta\left(1 - \frac{m}{\eta_1}l\sin\theta\right)d\theta}$$

The integral can be easily found by putting $\cos 2\theta = 2\cos^2\theta - 1$, and $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$.

This is merely put in as a matter of interest.

* The reader would do well to consult "The Dynamical Theory of Sound," by Horace Lamb.

IN THE DRAWING OFFICE

STRUT FAIRING.

By H. PARKINSON.

THE strut arrangement of External Bracing, Chassis, etc., often presents certain members at a compound angle, and the setting of streamline struts or fairings to offer their minimum frontal area to the direction of motion, under normal conditions of horizontal flight, requires special consideration with certain types of strut-end fixings.

settings can influence the design of the end fixing sockets. The latter in particular with the built-up type of streamline strut.

As some doubt often exists as to whether or not a setting is necessary, it will be more in order to examine that which influences the problem before offering a solution. Solutions are often tackled by taking sections at the centre of the strut, together with skew views for the purpose of bringing a true datum into the plane of the paper. This work tends to bring about complicated projections and makes the problem look more difficult than it really is.

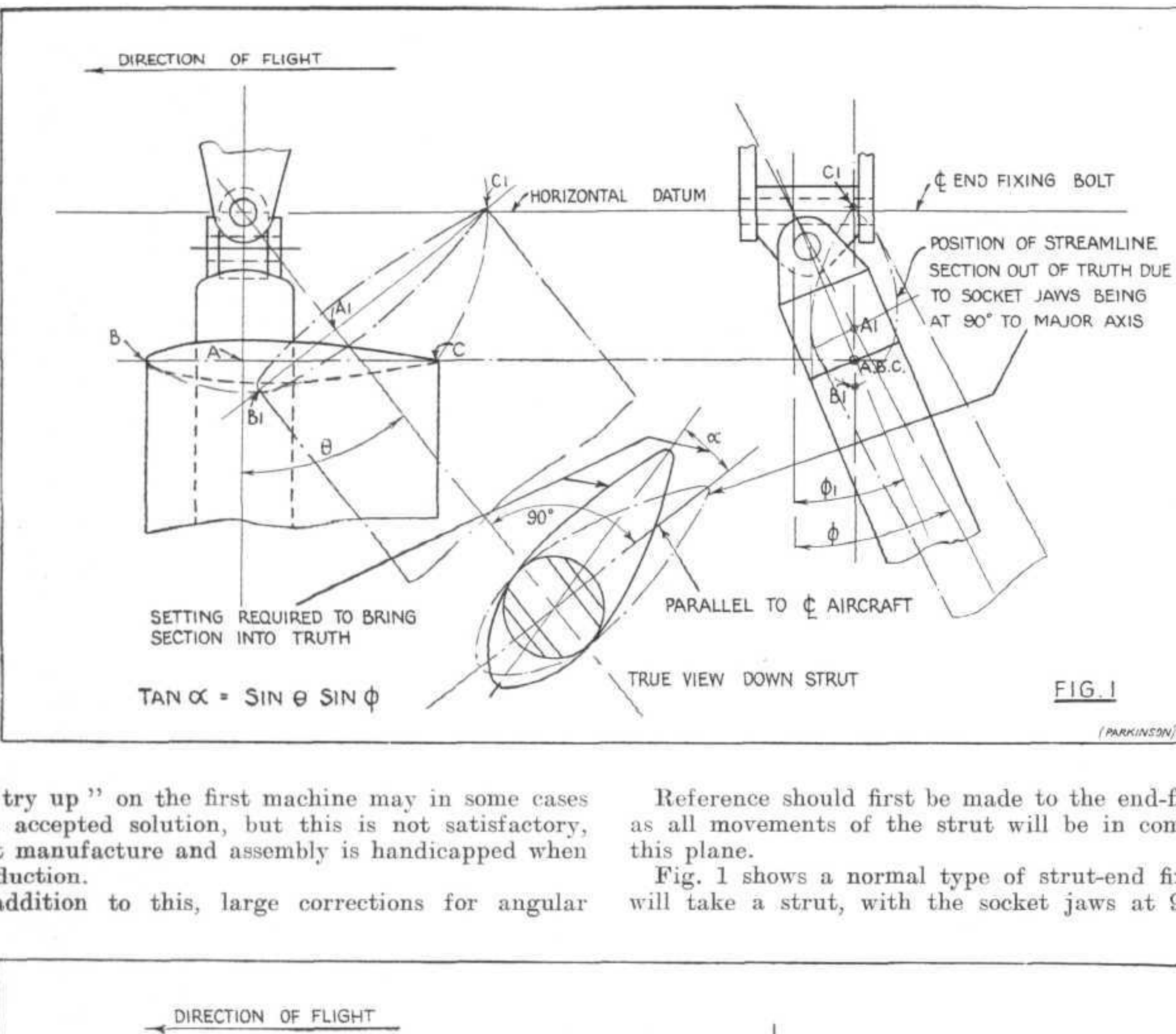


FIG. 1

A "try up" on the first machine may in some cases be the accepted solution, but this is not satisfactory, in that manufacture and assembly is handicapped when in production.

In addition to this, large corrections for angular

Reference should first be made to the end-fixing bolt, as all movements of the strut will be in common with this plane.

Fig. 1 shows a normal type of strut-end fixing. We will take a strut, with the socket jaws at 90 deg. to

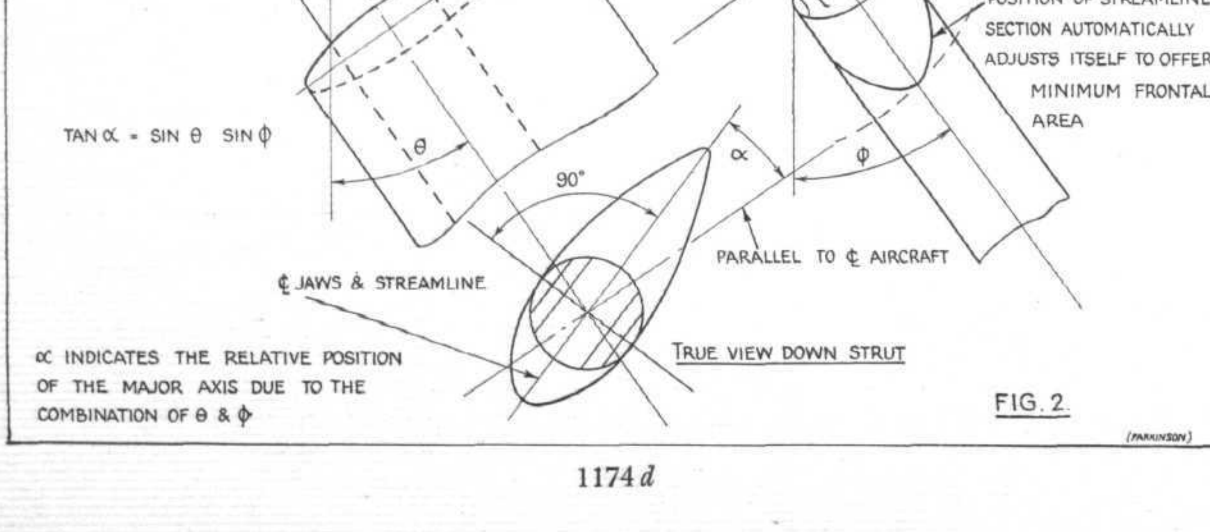


FIG. 2.

the major axis of the streamline, and bolt it in position on the shackle. The first operation is to move the strut through angle $\phi 1$ in end elevation; this is shown by the full-line sketch. We next move the strut back through angle θ, in side elevation, to take up the position shown in chain-dotted lines. It will be seen that angle $\phi 1$ becomes ϕ and that certain defined points, referred to on the strut-end section, will move as follows:—

B. (Leading edge) to B. 1.
A. (C.L. socket) to A. 1.
C. (Trailing edge) to C. 1.

In end elevation these points will move at right angles to the centre line of the appropriate end-fixing bolt, and cause the section to offer more than its minimum frontal area to the direction of flight.

The required setting of the streamline is shown chain dotted in the true view down the strut.

Fig. 2 shows another common type of strut-end fixing. As all movements of the strut are in common with the appropriate end-fixing bolt, it will be seen that fore-and-aft settings will not influence the alignment of the strut section. No correction is necessary in this case.

Due to the combination of angles θ and ϕ, however, the trailing edge will converge on the centre line of the aircraft. This setting is handy for running out clearances with adjacent structure.

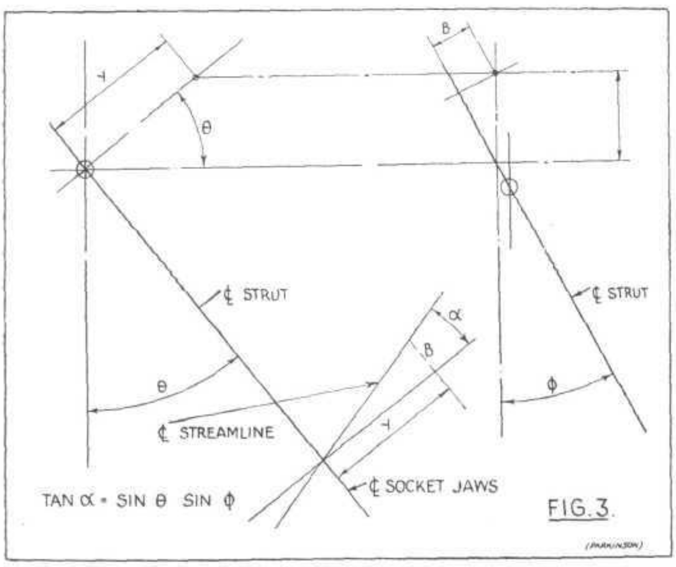


FIG. 3.

Referring to Fig. 3, which is a line diagram of Fig. 1 with certain data omitted for sake of clearness, the arithmetical solution is as follows. Drawing projection follows immediately from the figure.

$$\frac{A}{\gamma} = \sin\theta \qquad \gamma = \frac{A}{\sin\theta}$$

$$\frac{B}{A} = \sin\phi \qquad B = A\sin\phi$$

$$\frac{B}{\gamma} = \tan\alpha \quad : \quad \operatorname{Tan}\alpha = \frac{A\sin\phi\cdot\sin\theta}{A}$$

$$\therefore \tan\alpha = \sin\phi\sin\theta$$

Care should be taken in the handing of struts. As shown in the figure, when a strut slopes *backward* in elevation, a line produced from the leading edge through the trailing edge will converge on the centre line of the aircraft. The opposite is the case when the strut slopes *forward* in elevation.

INSPECTION OF WIRING PLATE ANGLES.

By D. MACLEAN BROWN, A.M.I.Mech.E.

ON wiring plates, similar to that shown in Fig. 1, a direct measurement of the angle between the lugs cannot be made with a bevel protractor, as the lugs do not lie in one plane.

A quick, simple, and reasonably accurate method of checking can, however, be made with no more elaborate tackle than a pocket square (or set square) and protractor.

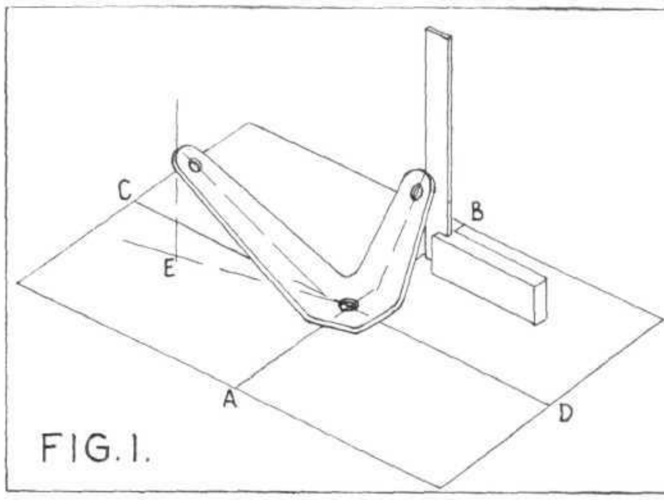


FIG. 1.

On an ordinary sheet of notepaper placed on the surface table, or drawing board, two lines, AB and CD, intersecting at right angles, are drawn. The centre of the bolt hole in the wiring plate is placed over the junction of the two lines, and the centre line of one lug, or the pin hole in that lug, is set perpendicular over one line by means of a square. See Fig. 1.

Holding the wiring plate in position with one hand, the square is removed with the other and applied to the centre line of the other lug.

The plate can then be removed and a pencil mark made on the notepaper at the edge of the square blade—E on sketch. If a line is drawn from this mark to the intersection of AB and CD, the developed angle between the lugs can be found with the aid of a protractor.

While the paper method is useful on odd occasions, a more permanent substitute is a piece of 16 G aluminium, either 6 in. diameter or approximately 8 in. by 5 in., with two centre lines scribed at right angles and one quadrant marked off in degrees.

Such a plate performs the same function as the notepaper, with the advantage that the angle can be read off immediately the square is applied to the second lug, the plate taking the place of a protractor.

The plate should, of course, be perfectly flat, and, if carefully made, is a useful gadget in the tool kit of the ground engineer and inspector.

If desired, a fixed plug, say, ¼ in. diameter, in the centre of the plate, with a few bushes to fit varying diameters of holes in wiring plates, enables these to be more readily centralised.

TECHNICAL LITERATURE

JAHRBUCH 1931 DER DEUTSCHEN VERSUCHSANSTALT FÜR LUFTFAHRT, E.V. BERLIN-ADLERSHOF.

Edited by WILH HOFF. 816 quarto pages, 1,407 diagrams and photographs, 233 tables. München, 1931, R. Oldenbourg. (Price 62 marks.)

The *Year Book* of the DVL (German Experimental Institute for Aviation) contains a Report on general activities during 1930-1931, and 260 investigations

summarised in abstracts, but about 58 of them are completely republished. About half of the last-mentioned Reports are published here for the first time, which means a departure from early practice. As an aid to readers who are interested in definite subjects only of the DVL work, the different parts of the *Year Book* are to be obtained as separate booklets. In this way one may have single Reports of the Research Departments for Aerodynamics, Statics, Engines, Materials, Aerial Photography and Navigation, Electrotechnics and Wireless, and Flying.

Many difficulties were caused by the delay owing to the removal of the DVL, although, to judge from the contents of the *Year Book*, it was possible to overcome successfully these hindrances. The *Testing Department* type-tested 65 new aeroplanes, 131 subsequent aeroplane-tests, and 748 periodical inspections were carried out. The number of engine type-tests is five, and those of the subsequent tests 269, and of periodical inspections there were 1,057. In a short space, it is impossible to attempt an account of all the subjects covered by the papers which have been published by the *Research Departments*, but a few of them which strike one by their novelty and importance may be cited.

Within the scope of the aerodynamic investigations may be mentioned model tests on artificial ventilation of engine test benches, and trial runs with the propeller-driven speed car. The Department for Statics publishes several Reports concerning the questions of structural requirements, and the results of tests with aircraft parts; two investigations relate to calculations of space framework. The papers of the Engine Department comprise mechanical properties of the parts of spark-ignition aero engines under different service conditions, trials with a super-charger, possibilities of waste gas jet propulsion, torsional oscillations of in-line engines, and studies of engine knocking.

Two very thorough investigations of the Materials Department relate, on the one hand, to welding properties of steel parts for aircraft; and on the other to static and dynamic strength of different light-metal alloys. Other papers deal with corrosion tests of sheet material and cables, trials with finishing materials, and engine tests with regard to fuel research. The Department for Aerial Photography and Navigation publishes, among others, a paper about checking of lenses with regard to distortion; and two others about increasing the sensitivity of photographic emulsions.

From the papers of the Electro and Wireless Department two new investigations may be cited. One relates to the influence of the position of the sun upon wireless waves, and the other to auto-direction finding by radio. The Reports of the Flight Department deal with the effect of Handley Page slotted ailerons, the influence of the slipstream upon the rudder, and determination of the effect of wing contours and aileron size **upon the lateral manœuvrability of monoplanes.**

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

EXPERIMENTS ON MODELS OF A COMPRESSED-AIR WIND TUNNEL. Compiled by R. Jones, M.A., D.Sc., and A. H. Bell. R. & M. No. 1355 (Ae. 486). (22 pages and 14 diagrams.) April, 1928. Price 1s. 3d. net.

The present report describes experiments conducted at the National Physical Laboratory on a model of a compressed-air tunnel, which is in course of erection at Teddington. The object of the investigation was to examine the uniformity of the flow of air in a suggested design, and to obtain an estimate of the power required to produce air currents of particular speeds.

A high-pressure tunnel must obviously be of the closed return flow type, and from considerations of strength to withstand the pressure (20–25 atmospheres) must be of circular section. Such a tunnel has for some time been in use in the U.S.A., but before proceeding to construct one in this country, experiments on a model were considered desirable in order to examine the possibilities of improvement in design both from the points of view of uniformity of speed and economy in the power consumption.

The report is divided into two parts. Part I deals with experiments on a model in which the outer shell was 9 ft. long. Various modifications, including in particular several systems of guide blades, etc., for ensuring a uniform distribution of flow and economic working from the point of view of power consumption were tried in this model. Having evolved a tunnel in which these points were considered satisfactory, the experiments were suspended at the termination of the work described in Part I. More substantial modifications were then suggested for introduction into the model with a view to further economy, not so much of working as of constructing and housing the tunnel. If the model could be shortened without detriment to the power factor and speed distribution, then obviously a great saving in cost of construction could be effected.

Part II describes the work carried out on the shortened model.

It was found that this could be adopted without any detrimental effects, and that the jet could be increased from 1 ft. to 1·345 ft. without increasing the diameter of the shell. The best power factor obtained for the long open-jet tunnel was approximately 1·4. This was improved and increased to 1·95 on the short model, a new screw being responsible for an increase from 1·5 to 1·7.

The distribution of velocity across the working section is very satisfactory. Yaw meter explorations show certain irregularities, which, however, change if the honeycomb be rotated about the centre line of the tunnel through 90°. This indicates that to some extent at least, the irregularities are governed by inaccuracies in the construction of the honeycomb.

The static pressure gradient is good, but the introduction of a ring to shield the balances, etc., increases the gradient. The experiments conducted give an adequate indication of the lines along which the gradient can be altered in the full scale tunnel if necessary.

VENTILATION OF 24-FT. TUNNEL. By B. Lockspeiser, M.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1372 (Ae. 499). (10 pages and 4 diagrams.) February, 1931. Price 9d. net.

In the 24-ft. tunnel it is proposed to test aeroplanes under flight conditions using the actual engine to drive the airscrew. The air circuit being closed, the concentration of the exhaust gases, both in the tunnel and the test chamber, will build up and quickly reach dangerous proportions.

Tests on a one-twenty-fourth scale model were designed to investigate :—(*a*) The effect of the ventilation on the velocity distribution in the jet. (*b*) The adequacy of the ventilation in restricting contamination of the air from exhaust gases of engines running in the tunnel. (*c*) The power required for ventilation.

With one side of the test chamber open, the variation from the mean velocity in the air jet has a maximum value of $\pm \frac{1}{2}$ per cent. whether the ventilation is in action or not. When the test chamber is closed the maximum variation is slightly increased.

In travelling round the tunnel the air and exhaust gases are thoroughly mixed, and the concentration of exhaust gases in the centre of the stream issuing from the jet is not appreciably different from that at the edge. It is estimated that with a volume of 250,000 cubic ft. of air per minute ventilating the tunnel, in which a 500-h.p. engine is discharging 50 cubic ft. of carbon monoxide per minute, the concentration of CO in the air issuing from the jet will be 3 parts in 10,000 when the steady state is reached. In the test chamber under these conditions the concentration of CO is found to be 1·2 parts in 10,000, which is considered to be safe.

With inlet and outlet areas of 150 and 200 sq. ft., respectively about 30 h.p. is required at zero tunnel speed to produce a ventilating stream of 250,000 cubic ft. per minute. As the tunnel speed increases, the demand on the ventilating fan decreases, until at full speed (about 120 m.p.h.) some 30 per cent. only of this ventilating power is required from the fan.

The ventilating air forms an annulus surrounding, and moving with, the main jet; this reduces the eddy formation at the open jet and the power demand on the tunnel motor. At the higher speeds this saving of power more than equals that required to draw the ventilating stream through the test chamber (ignoring all ventilating losses outside the test chamber).

It was also observed that the ventilation reduced the draughts in the air surrounding the jet due to the return of the surplus air picked up by the jet.

THE VARIATION OF VELOCITY IN THE NEIGHBOURHOOD OF THE THROAT OF A CONSTRICTION IN A WIND CHANNEL. By T. E. Stanton, F.R.S. R. & M. 1388 (Ae. 510). (3 pages and 2 diagrams.) May, 1930. Price 4d. net.

In R. & M. 1381* Professor G. I. Taylor discusses the effect of the convex surface of a body immersed in a stream of air in raising the velocity in its neighbourhood, and from approximate solutions of the equations of motion in two dimensions, he calculates the probable distribution of velocity in the neighbourhood of a surface of given curvature. As the problem is closely related to that of the flow of air through a constriction in a parallel pipe in which the velocity distribution can be measured with fair accuracy, experiments were made to find the extent to which Professor Taylor's solution applies to the three dimensional case in practice.

The constriction used consisted of a sleeve 2·8 in. in length inserted in a 3·07-in. diameter parallel channel, and had a longitudinal section consisting of two circular arcs of 6·6-in. radius distant 2·77 in. apart.

The observations taken were the velocity distribution along the axis and along a line parallel to the axis and 0·1 in. from the wall at the throat, and ranging from 0·3 in. above the throat to 0·3 in. below it.

It is shown in R. & M. 1382† that, when the speed of sound is first attained, disturbances confined to a thin layer, but resulting in a rapid thickening of it may occur. In support of this, a small but appreciable reversal of the static pressure gradient takes place at those speeds where the velocity of sound is exceeded and in the region in which Professor Taylor found evidence of a back flow in his observations on the Joukowski aerofoil.

* "The Flow of Air at High Speeds Past Curved Surfaces."—G. I. Taylor. R. & M. 1381.

† "Some Cases of Flow of Compressible Fluids."—G. I. Taylor. R. & M. 1382.

THE PROTECTION OF MAGNESIUM ALLOYS AGAINST CORROSION. By H. Sutton, M.Sc., and L. F. Le Brocq, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1390 (M. 73). (22 pages.) July, 1930. Price 1s. net.

The low density and useful mechanical properties of magnesium-rich alloys suggest their use in structures where lightness and rigidity are required, as, for example, in aircraft construction. Unfortunately, under the conditions under which many aircraft operate, another property of these alloys becomes of importance, *i.e.*, their susceptibility to corrosion, under marine conditions in particular.

Attempts have been made to minimise the action of sea-water spray on magnesium alloys by a number of methods.

An alloy of magnesium with about 2 per cent. of manganese appears to be somewhat more resistant to corrosion than commercially pure magnesium, but the improvement in corrosion resistance is not great enough for many purposes.

Sherardising, calorising, and the Schoop metal-spray process have all given poor protection when applied to a commonly used type of magnesium alloy.

No increase in corrosion resistance appeared to be afforded by the electro-deposition of zinc or copper on commercially pure magnesium over that obtained by the unplated metal.

Anodic films could be obtained on commercially pure magnesium from fluoride, carbonate, or phosphate baths. The protective action of these films, however, was poor.

An immersion process in which the work is immersed for six hours in a hot aqueous solution of potassium dichromate, potash alum and caustic soda, appears to be the best all-round treatment for magnesium or magnesium-alloy parts, especially if the work be subsequently coated with lanolin, or preferably enamelled.

SEVERAL CASES OF NON-CIRCULAR TORSION SOLVED BY ANALYSIS AND DIRECT TEST. By James Orr, B.Sc. Presented by Professor J. D. Cormack. R. & M. No. 1393 (Ae. 514). (21 pages and 28 diagrams.) September, 1930. Price 1s. 3d. net.

The purpose of the paper is to demonstrate an arithmetical trial-and-error process, solving the torsion problem for any chosen boundaries. By its use several British Standard structural sections, a shaft with keyway, a hollow square, a hollow serrated shaft, a circular shaft enlarging to greater diameter, and a shaft with a collar have been solved. These results are checked by tests in the case of the structural sections and hollow square by measuring both the twist and stresses. Also, the failure of a prism subjected to local high stresses is discussed.

A STUDY OF SLOTS, RINGS AND JET CONTROL OF THE BOUNDARY LAYER. By H. C. H. Townend, B.Sc. R. & M. No. 1394 (Ae. 515). (31 pages and 16 diagrams.) February, 1931. Price 1s. 9d. net.

A study has been made of certain cases of airflow in which various means are employed to control the behaviour of the air so as to prevent breakdown in the flow and the resulting turbulence. It is mainly an attempt to analyse the evidence which exists on such phenomena as slots, rings and boundary layer control by means of blowing through backwardly directed slots in the surface, and to determine if possible the extent to which their apparent similarity corresponds, if at all, to an identity of physical principle.

A great deal of experimental work has been done at various times on such devices, and in this paper some of the published results are discussed and an attempt made to correlate them. In addition, some further experiments have been made to fill up gaps in the data available, or to extend their scope. They include other examples of control of airflow at sharp corners (Part I); some of the cases considered differ widely from others, but all exhibit the reduction in eddying which results from assisting air to negotiate sharp corners or bluff obstacles with the least disturbance possible.

A study of these cases is made in Part II, where their points of similarity and difference are discussed and conclusions drawn with regard to the essential features of each of them.

ON THE INTERFERENCE OF A STREAMLINE NACELLE ON A MONOPLANE WING. By E. Ower, B.Sc., A.C.G.I., and C. T. Hutton, B.A. R. & M. No. 1395 (Ae. 516). (17 pages and 7 diagrams.) December, 1930. Price 1s. net.

These experiments arose from difficulties reported by the Society of British Aircraft Constructors in connection with the design of engine nacelles based on wind tunnel data. In order to determine the interference of a nacelle on a wing in the wind tunnel it is useless to attempt to work with a model of the nacelle and engine of such small size that detail cannot be faithfully represented, or that scale effect will invalidate the application of the model data to the full scale. The scale of the smallest complete model that can be used is thus fixed by the minimum size of the nacelle model dictated by such considerations. If we assume for this minimum size the somewhat low value of 6 in. maximum diameter, the length of the wing chord, estimated from the average proportions of modern aeroplanes, will be about 20 in. Thus, if a complete model is to be tested its wing span may well be too great to allow the work to be done in any but a large wind tunnel. It has therefore become the practice to work with partial models in which the nacelle is made to a convenient scale and only part of the wing span is included.

The primary object of this investigation was not to supply information directly applicable for design purposes, but to indicate the nature of the effects to be expected. The force measurements show that, without suitable fairing, very high interference drag is set up if the nacelle is very near the upper or lower surfaces of the wing, and that close proximity to the upper surface is much more detrimental than to the lower. Quite a small gap between wing and nacelle is, however, sufficient to reduce the interference considerably.

The flow past the wing may be affected for a distance of at least seven nacelle diameters on each side of the plane containing the nacelle axis. If, therefore, direct agreement over the whole flying range is desired between measurements made in the tunnel and in flight, at least this length of span must be included in the model, that is, a total wing span of about 7 ft. with a 6 in. diameter nacelle.

The investigation has shown that, provided there is no breakdown of flow—that is, provided the wing-nacelle combination is not aerodynamically bad—the problem can be treated by aerofoil theory. Apart from side effects, tests of partial models can therefore be used in these circumstances as a basis for the calculation of equivalent full-scale results. Aerofoil theory cannot be employed when a bad nacelle-wing combination causes a breakdown of flow equivalent to the stalling of part of the wing.

THE BREAKAWAY OF THE BOUNDARY LAYER ON A CIRCULAR CYLINDER AND AN AEROFOIL. By J. J. Green, A.R.C.Sc., B.Sc., D.I.C., Busk Student, Beit Scientific Research Fellow. R. & M. No. 1396 (Ae. 517). (3 pages and 5 diagrams.) May, 1930. Price 6d. net.

The work described in this paper aimed at a further analysis of the conditions existing at the point of breakaway of the boundary layer, as suggested in R. & M. 1313.* It was proposed in that report, that an examination for back flow in the region just behind the breakaway would be useful in indicating conditions existing in this neighbourhood.

A method was devised whereby the emission of titanium tetrachloride could be localised, the dense fumes then allowing visual and photographic examination of the direction of flow, at any desired point on the surface.

The results of the investigation indicate clearly that considerable back flow exists in the case of the circular cylinder, and in the case of an aerofoil

AIRSCREWS AT NEGATIVE TORQUE. C. N. H. Lock, M.A., and H. Bateman, B.Sc., D.I.C. R. & M. No. 1397 (Ae. 518). (6 pages and 5 diagrams.) January, 1931. Price 6d. net.

For some time past there has been considerable discussion on the relative drags of an airscrew rotating at zero or negative torque and of an airscrew at rest, when the engine to which the airscrew is attached is not working. At the request of the Aerodynamics Sub-Committee, a preliminary experiment has been carried out on an airscrew over the whole range from zero torque to airscrew stopped. It was hoped, from this test, to ascertain whether the variation in drag was of sufficient importance to warrant further research on this point.

The drag of a four-bladed airscrew of P/D ratio = 0·7 at zero torque was found to be somewhat less than that when stopped, the values of T_c being − 0·038 and − 0·050 respectively.

The comparison was extended to airscrews of different P/D ratio, the drag for the airscrew at rest being calculated by strip theory. The results indicate that for high-pitch screws there is considerable advantage in allowing the airscrew to rotate freely. Again, airscrews with more modern sections than those of the family of airscrews might be expected to have a much lower drag when rotating freely.

The thrust deduced from total head observations was in very poor agreement with that directly measured over the range in which the airscrew blades are stalled, although there is fair agreement down to maximum negative thrust. The calculations of airscrew performance by the vortex theory indicate that the theory breaks down over the stalled region.

A METHOD OF TESTING THE STRENGTH OF AIRCRAFT HULLS. By I. J. Gerard, M.Sc., Assoc.M.Inst.C.E. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1398 (Ae. 519). (7 pages and 10 diagrams.) November, 1930. Price 1s. 3d. net.

Up to the present time, there has been a scarcity of mechanical test results to support the allowable ultimate skin stresses usually assumed in stressing aircraft hulls and monocoque fuselages.

The duralumin hull built for the Kingston N. 9712 being available, tests were made in order to determine what ultimate stresses could be developed in the hull when loading systems comparable with those obtaining in service were applied.

Two types of test were made; one representing download on the tail, and the other representing alighting on two waves, one near the fore and one near the aft end of the waterline.

Ultimate skin stresses of approximately 7¼ tons per sq. in. were obtained in these tests.

THE RANGE OF AIRCRAFT AT HEIGHTS AS AFFECTED BY THE USE OF ALTITUDE CONTROL. FLIGHT TESTS ON AN AIRCRAFT WITH AN AIR-COOLED RADIAL ENGINE. By A. E. Woodward Nutt, B.A., Flt. Lt. A. F. Scroggs, B.A., D.I.C., R.A.F., and E. Finn, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1399 (Ae. 520). (8 pages and 16 diagrams.) November, 1930. Price 9d. net.

In a previous report (R. & M. 1317)† tests were described, in which the fuel consumption of an aircraft in level flight was measured at various speeds and heights, and the variation of the range of the aircraft with speed and height deduced. The results of these tests showed that when the maximum amount of altitude control possible without a fall in R.P.M. was used, there was a definite increase in the range of this aircraft with height at all air speeds. When rather more altitude control was used, higher ranges were obtained at the lower altitudes, making the range more nearly constant with height, although still showing an increase.

In an Appendix to the same report it was shown by Mr. H. T. Tizard that on theoretical grounds, the range of an aircraft should not vary appreciably with height if maximum fuel economy was obtained under all conditions. Maximum fuel economy would only be secured by operating on weak mixtures and by advancing suitably the ignition timing when the engine was throttled.

The fuel consumption of a De Havilland Stag aircraft fitted with a Jupiter VI engine was measured at a series of speeds in level flight at four heights. (*a*) With the maximum amount of altitude control possible without a fall in R.P.M. (*b*) With sufficient altitude control to cause a fall in R.P.M.

* R. & M. 1313. "The Viscous Layer Associated with a Circular Cylinder."—Green.

† R. & M. 1317. Flight tests on the variation of the range of an aircraft with speed and height. By Flight-Lieut. C. E. Maitland and A. E. Woodward Nutt.

of about 3 per cent. (c) With the amount of altitude control limited by stops fitted by the engine makers. This corresponds to ordinary Service use.

The greatest maximum range at all heights for this aircraft was obtained by the use of sufficient altitude control to cause a fall in the R.P.M. of about 3 per cent. ("Weak Mixture.") The maximum range then appears to remain constant with height.

With the maximum amount of altitude control possible without a fall in R.P.M. ("Normal A.C."), the maximum ranges are lower throughout, and there is a slight increase in maximum range with height. This increase is much smaller than that found for the Vickers' Venture. With the amount of altitude control limited by the stops, as in ordinary Service use of the aircraft, the ranges at all heights are considerably lower, and the maximum range appears to decrease with height.

Under both Normal A.C. and Weak Mixture conditions, the altitude control and throttle levers must be manipulated with more than ordinary precision to obtain consistently low consumptions, and when running on weak mixtures, the engine is unpleasantly "rough."

Retarding the ignition from 42° advance to 35° appears to cause increased consumptions at the lower throttle openings.

MEASURED SPINS ON AEROPLANE H. By S. B. Gates, M.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1403 (Ae. 524). (5 pages and 3 diagrams.) April, 1931. Price 6d. net.

As a preliminary to spinning experiments with a raised tailplane, a cautious exploration of the spin of Aeroplane H was attempted. Records of normal acceleration, rate of turn and rudder movement were made in spins to right and left under conditions to give maximum ease of recovery. The entrant rudder angle was limited to 12° in right-hand spins.

Spins in either sense are characterised by a few slow steep turns, followed by a flick into an extremely fast and flattish spin (time of turn 1·2 secs., incidence 57°). Recovery is immediate if attempted before the flick, and not difficult in spins to the left if delayed till after the flick. Recovery from the fast spin to the right is extremely difficult, and the experiment was discontinued after two such spins, in which 40 and 34 turns were made before recovery, had been done.

The high rate of rotation has a confusing effect on the pilot, who is liable to lose his sense of direction of the rudder control, and also may find it difficult to hold full rudder against the spin for a long enough time to ensure recovery.

TAKE-OFF AND LANDING OF AIRCRAFT. By D. Rolinson, M.Eng. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1406 (Ae. 527). (25 pages and 26 diagrams.) June, 1931. Price 1s. 9d. net.

There have always been considerable differences in the measurements of landing and take-off runs of an aircraft on a given day. The standard method used to determine these distances is direct measurement, the points of touching the ground and taking off being spotted by two observers. To determine height cleared, a photograph of the aircraft is taken at an arbitrary distance from the start of a run and the scale for measurement depends for accuracy to some extent on the judgment of an observer. Errors of measurement are considerable but do not account for the marked differences obtaining. Further, the standard method does not give distance to clear a given height either taking off or landing. A camera was therefore made up at this station to give a reproduction of a take-off by taking a series of photographs at half-second intervals on one plate, from the start of the aircraft, to the time when it was 60 ft. or more above the ground. By this means the flight path of the aircraft was obtained, and it was possible to give a reasonable estimate of the distance necessary to clear a given obstacle. The accuracy of this method depended only on the accuracy of measurement of the distance from the camera to the course along which the aircraft took off. A second instrument, a modification of a panoramic camera, was made at R.A.E., and with this camera runs of seven aircraft, four biplanes, and three monoplanes were obtained. The results form the basis of this report.

Lift and drag coefficients have been calculated from the results calculated from the film records, and for two aircraft, the Wapiti and the Virginia, full scale determination of the coefficients was made at a height of 2,500 ft. for comparative purposes. A few tests were carried out to discover whether a rapid increase of angle of attack gave an increase of lift-coefficient showed a slight increase.

It has definitely been established that an aircraft can take off and land at a speed much below that appropriate to the incidence obtaining; that the lift-coefficient for an aircraft near the ground is much higher than would be expected for the same incidence in free air in steady flight. It is shown that it is possible to obtain the distance necessary for a landing or take-off to be effected when a given height has to be cleared. It is also shown that it is within the power of the pilot to modify this distance considerably.

ON THE RELATION BETWEEN HEAT TRANSFER AND SURFACE FRICTION FOR LAMINAR FLOW. By A. Page, A.R.C.Sc., and V. M. Falkner, B.Sc. R. & M. No. 1408 (Ae. 529). (30 pages and 12 diagrams.) April, 1931. Price 1s. 6d. net.

The heat transfer from a surface immersed in a moving fluid depends not only on the surface friction, but also on the general fluid flow in the neighbourhood of the surface. Any attempt to obtain a theoretical relation between heat transfer and surface friction necessarily involves therefore the establishment of a connection between surface friction and the neighbouring fluid flow, and consequently the problem must be restricted to those types of motion for which such a connection can be found. There appear to be only two types of motion for which this requirement can be fulfilled; first, flow in pipes, the second, flow past surfaces, for which the boundary layer theory is applicable.

The paper gives a mathematical theory of the heat transfer from a surface over which the fluid flow in the boundary layer is laminar and two-dimensional, when the heat flow is steady. A general differential equation for heat transfer has been obtained from a consideration of the heat balance at any point in the boundary layer, and after simplification, this equation has been solved by artifices similar to those used to obtain a solution of the boundary layer equations.

The solutions obtained were adapted to two problems of practical interest, (a) the heat transfer from a plane placed in a fluid stream in the direction of motion, and (b) that from a generator strip of a circular cylinder. In each case relationships were obtained between the intensity of heat transfer and surface friction. These theoretical relationships were compared with those obtained from measurements of the heat transfer from a thin platinum foil placed in a wind stream and from a nickel strip embedded just below the surface of a cylinder. The intensity of surface friction for the platinum foil was known theoretically, and that for the cylinder was taken from earlier experiments.

The agreement between theory and experiment was close for both the plate and cylinder.

SUMMARIES OF N.A.C.A. TECHNICAL REPORTS

The National Advisory Committee for Aeronautics is the American equivalent of our Aeronautical Research Committee, with headquarters at Washington, D.C. The Technical Reports issued by the N.A.C.A. are obtainable from the Superintendent of Documents, Washington, D.C., U.S.A. *In the summaries printed below the prices* of Reports are given. These prices are net, and a small amount should be added to cover postage. For the guidance of potential purchasers it may be pointed out that the Reports rarely exceed 5 oz. in weight.

No. 380. PRESSURE DISTRIBUTION OVER THE FUSELAGE OF A PW-9 PURSUIT BIPLANE IN FLIGHT. By Richard V. Rhode and Eugene E. Lundquist. Price 20 cents.

This report presents the results obtained from pressure distribution tests on the fuselage of a PW-9 pursuit aeroplane in a number of conditions of flight. The investigation was made to determine the contribution of the fuselage to the total life in conditions considered critical for the wing structure, and also to determine whether the fuselage loads acting simultaneously with the maximum tail loads were of such a character as to be of concern with respect to the structural design of other parts of the aeroplane. The tests were conducted by the National Advisory Committee for Aeronautics at Langley Field, Va., during the spring of 1929. The results show that the contiribution of the fuselage toward the total lift is small on this aeroplane, ranging from slightly less than 3 per cent. at the lower angles of attack to about 4 per cent. at the higher angles, which approximately compensates for the portion of the wing area replaced by the fuselage. Aerodynamic loads on the fuselage are, in general, unimportant from the structural viewpoint, and in most cases they are of such character that, if neglected, a conservative design results. In spins, aerodynamic forces on the fuselage produce diving moments of appreciable magnitude and yawing moments of small magnitude, but opposing the rotation of the aeroplane. A table of cowling pressures for various manœuvres is included in the report.

No. 381. STATIC, DROP, AND FLIGHT TESTS ON MUSSELMAN TYPE AIRWHEELS. By William C. Peck and Albert P. Beard. Price 15 cents.

This investigation was conducted at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics during the period from January to July, 1931, for the purpose of obtaining quantitative information on the shock-reducing and energy-dissipating qualities of a set of 30 by 13-6 Musselman type airwheels. The investigation consisted of static, drop, and flight tests. The static tests were made with inflation pressures of approximately, 0, 5, 10, 15, 20 and 25 lb. per sq. in., and loadings up to 9,600 lb. The drop tests were made with inflation pressures of approximately 5, 10, 15, 20 and 25 lb. per sq. in., and loadings of 1,840, 2,440, 3,050 and 3,585 lb. The flight tests were made with a VE-7 aeroplane weighing 2,153 lb., with the tyres inflated to 5, 10 and 15 lb. per sq. in. The landing gears used in conjunction with the airwheels were practically rigid structures. The results of the tests showed that the walls of the tyres carried a considerable portion of the load, each tyre supporting a load of 600 lb with a depression of approximately 6 in. The shock-reducing qualities, under severe tests, and the energy-dissipating characteristics of the tyres, under all tests, were poor. The latter was evidenced by the rebound present in all landings made. In the severe drop tests, the free rebound reached as much as 60 per cent. of the free drop.

The results indicate that a shock-reducing and energy-dissipating mechanism should be used in conjunction with airwheels.

No. 384. THE COMPARATIVE PERFORMANCE OF SUPERCHARGERS. By Oscar W. Schey Price 5 cents.

This report presents a comparison of superchargers on the basis of the power required to compress the air at a definite rate, and on the basis of the net engine power developed at altitudes from 0 to 40,000 ft. The investigation, which was conducted at the Langley Memorial Aeronautical Laboratory, included geared centrifugal, turbine-driven centrifugal, Roots, and vane-type superchargers. It also includes a brief discussion of the mechanical limitations of each supercharger, and explains how the method of control affects the power requirements. The results of this investigation show that for critical altitudes below 20,000 ft. there is a maximum difference of about 6 per cent. between the amounts of net engine power developed by the various types of superchargers when ideal methods of control are employed, but for critical altitudes above 20,000 ft. an engine develops considerably more power when equipped with a turbo centrifugal supercharger than with any other type. The Roots type gives the lowest net engine power of all at high critical altitudes, because it has the least efficient type of compression. The throttling method of control used on the geared-centrifugal type of supercharger is very unsatisfactory at low altitudes from a net engine power standard when compared with the method used on the Roots or turbine centrifugal type.

Air Transport

COMMERCIAL FLYING IN SIAM

It was my privilege recently to be in Siam in an official capacity which afforded me an unique opportunity of studying Siamese aviation at first hand. Before dealing with the civil side of flying, it should be mentioned that the Siamese Air Arm is gaining steadily in strength and gradually obtaining up-to-date machines, although the old Breguet and Le Rhone Nieuports are still in regular use. Some Avros are used for training, and a few months ago the Government purchased a Curtiss Scout and Bristol "Bulldog." The training of pilots is fairly comprehensive, but not up to the standard of the leading European nations. The Siamese pilot is not lacking in pluck, but has not a highly keen sense of imagination, which is an essential to first-class pilotage.

In aviation, as in other matters, the Siamese is inclined to treat matters in the light of a game or a new toy, which probably accounts for the number of accidents, fatal and otherwise, full particulars of which are never obtainable owing to Press censorship. Although for most of the year the weather is excellent for flying there did not appear to be the amount of intensive training there should be, and in the wet season the Siamese are handicapped by the waterlogged condition of their chief aerodrome situated at Don Muang on the railway some 40 kilometres (25 miles) north of Bangkok. This aerodrome, which covers a large area, has a portion at the southern end which is raised sufficiently to make is usable in all but the worst weather. The cost of upkeep of Don Muang is very considerable, owing to the continual pumping operations and renewals of surface. It is merely a large group of paddy fields with the intervening retaining banks levelled off. There are plenty of hangars and a very complete number of iron sheds housing aeroplane repair and engine testing departments. Don Muang is the only available aerodrome for Bangkok, although there is an excellent piece of ground opposite the Royal Palace in the City. This would be eminently suitable and has been suggested as a future air terminus. Unfortunately, this is a military parade ground, and, owing to the usual interdepartmental friction found in independent countries of the Far East, little progress has been made in coming to some arrangement.

Recently the Aerial Transport Co. of Siam was formed for the purpose of carrying mails, passengers and express packages. Prior to this the mails were carried by the Army machines for a subsidy of Ticals 45,000 per annum. The Army authorities claimed that the amount was totally insufficient, and asked for approximately double the amount. This naturally gave an impetus to an already formed idea of starting a civil line, and met with the approval of Prince Purachatra, who is Minister of Commerce, etc., and wields considerable power in Siam. The management was for some reason or other placed in the hands of the Postal Adviser, an American. The company was duly formed with a nominal capital of Ticals 600,000 and a board of directors composed of chiefly Siamese, but containing two foreigners.

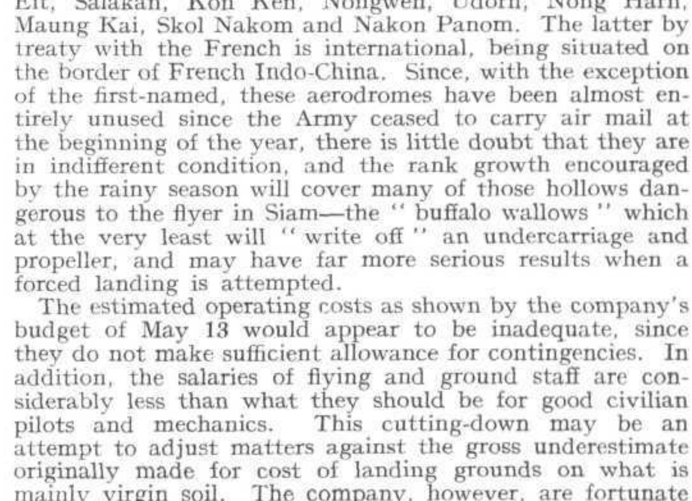
It is of interest to note that the actual financing of the company has been done by the Siamese Treasury as and when funds were required on approved demand. The company ordered four D.H. "Puss Moths" and commenced some operations after many delays in August last over the central part of Siam, using Korat, 220 km. N.W. of Bangkok, as the base; mails thence to Bangkok to be sent by rail. A foreign operations manager, a pilot of considerable experience, was engaged, but on getting the machines to Don Muang, to which place they were ordered by the authorities, instead of being sent direct in cases to Korat, the aircraft were taken over by the Army Flying Services and assembled and tested without any reference being made to the foreign civil pilot—and no facilities or information were offered as to official requirements and method of procedure beyond the production of a copy of the Siamese Government "Air Regulations," which was based solely on the international code and book copies of airworthiness forms, which did not exist in sheet form.

The proposed route to be primarily covered by the air mail is from Korat to Roi Eit, 200 km. (124 miles); Roi Eit to Kon Ken, 105 km. (65 miles); Kon Ken to Udorn, 100 km. (62 miles); Udorn to Nakon Panom, 210 km. (130.5 miles), and return; the object being to cover the settled districts of Siam not yet supplied with rail transport. Owing to the lack of roads that portion of Siam, as in most parts, is dependent on ox-cart transport. In addition, a freight run direct from Korat to Kon Ken and Udorn along the rail line under construction is intended with two "Puss Moths" fitted with pilot's seat only. The chief aerodromes over this route would be those mentioned above, with, in addition, emergency landing grounds approximately 50 km. (31 miles) apart. Of all the aerodromes listed in the company's prospectuses and those projected only one was in usable condition last July; this was Korat. Pimai, an emergency ground on the line to Roi Eit, was under construction.

There are Army aerodromes at Korat, Para Kapon, Roi Eit, Salakan, Kon Ken, Nongwen, Udorn, Nong Harn, Maung Kai, Skol Nakom and Nakon Panom. The latter by treaty with the French is international, being situated on the border of French Indo-China. Since, with the exception of the first-named, these aerodromes have been almost entirely unused since the Army ceased to carry air mail at the beginning of the year, there is little doubt that they are in indifferent condition, and the rank growth encouraged by the rainy season will cover many of those hollows dangerous to the flyer in Siam—the "buffalo wallows" which at the very least will "write off" an undercarriage and propeller, and may have far more serious results when a forced landing is attempted.

The estimated operating costs as shown by the company's budget of May 13 would appear to be inadequate, since they do not make sufficient allowance for contingencies. In addition, the salaries of flying and ground staff are considerably less than what they should be for good civilian pilots and mechanics. This cutting-down may be an attempt to adjust matters against the gross underestimate originally made for cost of landing grounds on what is mainly virgin soil. The company, however, are fortunate in having the services, loaned by the railway company, of Mr. Gibb, who thoroughly appreciates the difficulties ahead, but who will, with the proper backing, overcome them, no matter what they may be.

When the central route has been developed it is intended with heavier machines to run mail connecting Hanoi, Bangkok and Rangoon, taking the southern routes through the mountains on the east and west of Siam. On the Western ranges emergency grounds will probably be made



Sketch map of Siam showing the principal air and land communications

at Meh Sord and Ra Heng, permitting the pilot to land in the event of bad weather on either the east or the west side of the range.

The Dutch and French air mail run regularly through Siam, landing at Don Muang, and latterly a new aerodrome has been built at Hua Hin on the south-east coast. This ground did not at first prove satisfactory, owing to the appearance of an unexpected earth fault, but if the work is carried out efficiently, without too much regard for economy as against safety, should prove most useful to international pilots in the monsoon season.

Siam offers great possibilities in aviation, despite the difficulties of forced landing grounds owing to the large areas of paddy fields, but there is much to be done.

Australian Xmas Air Mail

THE Australian National Airways Avro 10 *Southern Sun* arrived at Melbourne from Hobart on November 19. Thence the journey was resumed to Darwin via Sydney and Brisbane, Darwin being reached on November 22. Leaving Darwin next day the machine flew to Koepang and Bima, arriving at Batavia on November 24. Mr. G. U. Allan is chief pilot, Mr. B. S. Calligan second pilot, and Col. Brinsmead, Controller of Civil Aviation, is a passenger. About 53,000 letters are being carried.

Last-Minute Air Mails

URGENT letters for the air mails to Paris, India and Africa may now be posted in a special box at Imperial Airways offices at Victoria up to a minute before the departure of the motor coach for Croydon. This allows an extra three-quarters of an hour to catch the mails. Hitherto, letters have been accepted at the General Post Office up to 11 a.m. for despatch on the daily service to Paris, on the Wednesday service to Africa, and the Saturday service to India. They may now be posted at Victoria up to 11.44 a.m.

A Bristol-Cardiff Air Service?

BRISTOL to Cardiff has for some time been looked on as one of the routes which would most readily lend itself to a regular air service, or perhaps an air ferry, if only because of the number of business people who travel between the two cities daily. The railway journey, via the Severn Tunnel, takes approximately one hour and twenty minutes, and by car considerably longer. As the crow and the aeroplane flies the distance is just over twenty miles, involving 15 minutes' flying. With the object of demonstrating the possibilities of an air ferry between Bristol Airport and the Cardiff Municipal Aerodrome, the *Bristol Evening Times* has chartered an Imperial Airways Avro 10, and intends running a twice-daily service for one week early in January. If the service is well supported it is an economical proposition to charge passengers little more than a first-class railway fare, and, assuming that the time of the West of England and South Wales business man is of any value, the saving on the journey should be well worth while. Apart from thick fog, it should be possible for the flight to be made in any weather conditions, as there is no high or difficult ground between the two aerodromes, and it is for this reason that the *Evening Times* decided to make their demonstration in the winter. Since the opening of the Bristol Airport the question of traffic to South Wales has always been a subject of discussion, and through the generosity of the *Bristol Evening Times* the views of those interested will now be put to a practical test. The full details of the service will be announced later.

An "Aerial Coach" Service?

BRIAN LEWIS & Co., LTD., have just supplied a new "Puss Moth" to the order of Mr. E. Hillman, of Hillman Saloon Coaches. This machine is the first of a fleet with which Mr. Hillman proposes to operate an air line and taxi service from his own aerodrome at Brentwood. Mr. Hillman started a motor-coach business three years ago with one vehicle, and he is now head of a company which operates a hundred. He is convinced that a like rate of progress is possible in air passenger work if it is organised on motor-coach lines and has the benefit of motor-coach booking organisations.

That "Parcel Post Passenger"

REPORTS were published in the daily Press recently of a civil engineer having travelled by air from Croydon to Africa at parcel post rates. We understand from Imperial Airways that this was not the case, the gentleman in question travelling at ordinary passenger rates.

10 Years of "Deruluft"

ON November 23 the German-Russian Air Traffic Company "Deruluft" celebrated its tenth birthday. The company has worked itself up from very modest beginnings to be an important link in the European air net system. To begin with the "Deruluft" started with a twice-weekly service between Koenigsberg, in East Prussia, and Moscow, and the annual "mileage" was originally 148,000 km. To-day the annual mileage flown by the company's machines is in the neighbourhood of one million km. and the service is operated daily. During the past season "Deruluft" machines carried, on the routes Berlin-Koenigsberg-Moscow and Koenigsberg-Riga-Tallin-Leningrad 115 tons of goods, 30 tons of mails, and more than 3,600 passengers. These figures compare with 19 tons of goods, one ton of mails, and 338 passengers in the first year of operation.

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"Air Flow"

ON Thursday, December 10, Mr. W. S. Farren, M.B.E., M.A., F.R.Ae.S., M.I.Ae.E., will give his lecture "Air Flow" before the Royal Aeronautical Society with demonstrations on the screen by means of smoke. In this remarkable lecture Mr. Farren will make visible the actual air flow over various shaped bodies by means of apparatus which he has specially developed for the purpose. He will also show a number of slides of the flow of water past various shaped bodies. The lecture will demonstrate, as can be done in no other way, some of the real problems and difficulties in aeroplane design from the aerodynamical point of view. The lecture will be held in the Lecture Hall of the Royal Society of Arts, at 6.30 p.m.

A Very Interesting Lecture

SIR GILBERT WALKER lectured on the subject of "Clouds" before the Imperial College Gliding Club, the British Gliding Association and the London Gliding Club at the City and Guilds College, Exhibition Road, S.W.7, on Monday, November 23, at 5.30 p.m. With an exceptionally fine set of slides Sir Gilbert explained all the different forms of clouds, together with their meanings and the manner in which they are evolved. He also explained at length a series of interesting experiments that he had carried out in the laboratory on the artificial formation of clouds, experiments which throw a very great deal of light on the subject and which, when interpreted, have assisted in the forecast of weather conditions. Such information is of vital importance, not only to gliding enthusiasts but also flying men in general, for there is no doubt that the more a pilot knows of meteorology the better pilot he is. Sir Gilbert finished his lecture with a plea for more people to take up the fascinating pastime of photographing clouds. He said, that for this purpose it was necessary to use a coloured screen and panchromatic plates, together with an aperture of F.4.3 as a minimum.

"Wheel Brakes and Undercarriages"

ON Thursday, December 3, Mr. S. Scott Hall, M.Sc., D.I.C., A.F.R.Ae.S., will deliver his lecture on "Wheel Brakes and Undercarriages" before the R.Ae.S. in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2, at 6.30 p.m. The first half of the lecture, which will be very fully illustrated with slides and a film, will cover all the various types of wheel brakes which have been tried and tested, and the problems which have had to be faced and are now in the process of solution. In the second part of his lecture Mr. Scott Hall will deal with the general aspects of undercarriage development, the types in use, the loads they may be called upon to carry under varying conditions of landing, their drag, etc. Mr. Scott Hall will demonstrate a model wheel and show various types of brake units.

Squash Rackets : R.A.F. *v.* R.Ae.C.

THE Royal Aero Club beat the Air Ministry in the Royal Aero Club's Court on Tuesday, November 17, 1931, by three matches to none. The results were:—

P. de L. Cazenove (Royal Aero Club) beat Flt. Lt. H. M. Mellor (Air Ministry) (9—5, 9—1, 9—3).

T. D. Morison (Royal Aero Club) beat Flt. Lt. I. E. Brodie (Air Ministry) (9—4, 9—4, 9—3).

B. F. H. Maturin (Royal Aero Club) beat Flt. Lt. S. L. G. Pope (Air Ministry) (9—6, 9—0, 9—1).

Airport News

CROYDON

QUITE a large number of extra machines has been arriving from all Continental countries, especially Germany and Belgium, during this week, and one is forced to the conclusion that the dumping frenzy has spread to many foreign manufacturers, who realise the speed of air freighters. Thousands of watches, articles of jewellery, silk, and fancy goods have arrived, and as many as three extra machines daily have been used to bring this type of foreign produce to Croydon. The air lines concerned are reaping a rich harvest. It is to be hoped that the foreign manufacturers, having once realised the value of air transport, will continue to use the airway in the future.

When Mr. Nevill Vincent left on the Avro X for India on Friday, the weather was decidedly bad, but he reached Paris in good time. This machine is to be used for the personal use of the Viceroy. Prior to the present Viceroy's departure for India, he took a great interest in aviation, and was often to be seen at Shoreham aerodrome.

Another Handley Page 42 has left for the Eastern section of Imperial Airways, this time piloted by Mr. Wilcockson, assisted by Mr. Foy. The sixth Handley Page 42 has also been delivered, and this only leaves two more to arrive. The new Armstrong Whitworth monoplanes will now be awaited with great interest.

The aerodrome buildings are undergoing a wash and brush up, a squad of whitewashers and painters being busy in the customs and main halls. They have an enormous adjustable platform which they push about, so anyone having to pass beneath can do so without fear of themselves receiving a coating.

A further section of ground in front of Imperial Airways hangars is under treatment with the patent tar and earth mixture which has been previously used with much success. This will give the company a much larger space for manœuvring their machines in and out of the hangars. The ground itself in this section could not be used before, on account of its uneven surface.

British Air Transport have acquired another Klemm—fitted with a Salmson engine. Come on fellows—what about buying BRITISH! The company now have a fleet of fine aircraft, and is doing good business.

Sunday was a blank day so far as Continental aircraft were concerned. Fog was general everywhere, and it was the first day for a long time that services had to be cancelled. The school machines, and joyriders, however, managed to get in a reasonable week-end in spite of the weather.

It is understood that a special mail-carrying machine left Sydney, Australia, during the week-end with Christmas mail. It is due at Croydon about December 2, and it is proposed to return to Sydney with mails from England reaching there in time for Christmas morning delivery.

Miss Peggy Salaman is on her way home from the Cape, and according to her publicity department, proposes to fly from Southampton to Croydon.

The traffic figures for the week were:—Passengers, **562**; freight, **64** tons.

P. B.

FOR THE VICEROY OF INDIA: The Avro 10 which left Croydon for India, piloted by Mr. Nevill Vincent, on Nov. 20. This machine is intended for the personal use of Lord Willingdon, Viceroy of India.

NEW WIRELESS BEACON FOR CROYDON

A NEW type of wireless directional Beacon station is to be erected at the London Air Port, Croydon, by the Marconi Company to the order of the Air Ministry. Known as the Marconi visual-type course indicator, the new station represents the latest means of assisting aerial navigation by wireless, and it will act as an automatic guide to aircraft approaching and leaving the aerodrome on the Continental route.

By watching a single dial, controlled by wireless from the beacon station on the ground, the pilot of an aeroplane, fitted with a special light-weight beacon receiver, will be able to see immediately whether he is on his correct course or whether he has deviated to the right or to the left.

The dial, which is connected with the receiver, has a black background on which appear two vertical white lines. If the aircraft deviates to either side of the correct course, the white line on that side of dial increases in length and the white line on the other side decreases. The instrument thus gives a direct indication of course, and is as simple to read as the familiar speedometer or oil-pressure dials. No tuning or adjustments are required, as the beacon transmitter and the automatic receiver operate on a fixed wavelength.

Method of Operation.—The course-indicator transmitting station emits, from an aerial system, consisting of two loops arranged at an angle, a "beam" emission on each side of the air route, so that an aircraft travelling on the correct route receives the signals of the two wireless beams at equal strength.

On the dial of the instrument in the cockpit, the two white lines, which are, in fact, the ends of a pair of rapidly-vibrating reeds, are equal in length—that is, the reeds are both vibrating at the same amplitude.

If, however, the aircraft deviates from the correct route, one beam is received at greater strength, and as the two beams are modulated at different frequencies, the reed which is tuned to the frequency of the stronger signal vibrates more strongly. The visual line depicted by the end of this reed on the dial thus becomes longer, while the vibrations of the other reed weaken, and the corresponding visual line shortens.

In this way the pilot is immediately warned of his deviation and of the direction in which he should steer for its correction. In effect, he has only to "steer towards the shorter line," until the reeds are again balanced, in order to regain his course. The vibration of the reeds is scarcely observable on the dial of the instrument, the visual effect being that of white lines, the relative lengths of which give the required guidance.

The Croydon Beacon.—Visitors to Croydon will shortly see the special aerial system of the Marconi visual-type course indicator in course of erection. It will consist of two Bellini-Tosi triangular "loops" supported by a lattice-steel tower, 100 ft. in height. The base of each loop will be approximately 300 ft. in length, and the outer extremities will be carried on steel jury masts some 20 ft. from the ground, and kept taut by a system of counter-weights. At mid-point in each bottom wire of the loops a further supporting jury mast and insulator will be erected to take part of the weight of the span and to preserve the directional characteristics of the loops under windy conditions, by the prevention of side sway.

The transmitter will comprise a drive circuit and two intermediate amplifier stages, each followed by a power amplifier stage.

The drive will consist of a high-frequency oscillation generating circuit employing one valve and tuned to 306 kilocycles, the oscillations of which will be applied to the grids of each intermediate amplifier. These will each employ a single valve, the anode being fed by high-tension direct current upon which will be superimposed an alternating potential generated by separate alternators for each intermediate amplifier, at frequencies of 65 and 86.7 cycles respectively. The outputs of the amplifiers, modulated to these frequencies, will then be passed to the power amplifiers, each of which will have an input of 1 kilowatt to the anodes and will operate into one of the goniometer stators.

Receiving Equipment.—Receiving equipment for the aircraft will employ a vertical rod aerial approximately 10 ft. in length of stream-lined cross section mounted on the fuselage, or in any other convenient situation.

The components of the receiver will be mounted on a screened metal chassis contained in a metal case with shock-absorber suspension, the receiver circuits comprising three tuned high-frequency amplifier circuits with ganged controls, and a detector, followed by low-frequency magnification.

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AIRCRAFT VIBRATION

From the paper under this title read by H. Constant, M.A., A.F.R.Ae.S., before the Royal Aeronautical Society on November 19 we have space to quote only the following passages, the paper being of such a highly technical nature that it cannot, however valuable in itself, be assumed to be of very wide general interest.—ED.

The Reduction of Vibration

THE most effective method of reducing vibration is the reduction or complete removal of its source.

In ungeared, unsupercharged power plants the engine is probably the cause of more serious vibration than is the airscrew. The introduction of gearing has had the effect of magnifying the airscrew's contribution to vibration, while supercharging of the engine has resulted in the decrease of a considerable part of the engine's vibration, probably due to improved distribution. As a result, the airscrew is now very frequently the chief source of bad vibration.

The most effective method of reducing airscrew vibration is the fitting of a three- or four-blade airscrew. The result of this is the elimination of the vibration due to aerodynamic and gyroscopic couples, the chief source of vibration on the turn and in other manœuvres. If, in addition, the airscrew be dynamically balanced, the result should be an airscrew with practically no inherent tendency to cause vibration.

With regard to the engine, a reduction in vibration will follow on improvements in the balance, more particularly the secondary balance. The addition of a supercharger will improve the distribution and decrease the vibration due to torque reaction. The correct tuning of the carburettor, the supply of adequate heat to the air intake, carburettor and induction pipe, all serve to reduce the vibration caused by the harmonics of the engine torque reaction.

When all possible has been done to reduce the sources of vibration, a further improvement may be obtained by the insulation both of the sources and of individual parts of the structure or fittings of the aircraft by the use of rubber or some other medium for absorbing vibration. It is also probable that the introduction of suitable vibration dampers would have a beneficial effect. A study of the effect of these is, however, beyond the scope of this paper.

Summary and Conclusions

We will conclude this survey of aircraft vibration with a brief summary of the main points that have been made. Starting with a study of the modes of vibration of a fuselage, we have shown how, for flexural vibration, the fuselage may have several modes of vibration in each of its two planes of vibration. When any source of vibration synchronises with the frequency of one of these modes, a resonant vibration is set up. Thus for flexural vibration in both the horizontal and the vertical planes there are several engine speeds at which resonance of some source of vibration occurs. The same state of affairs applies to the fuselage torsional vibration. Vibration of parts of the aircraft other than the fuselage has not been considered.

In order to obtain some idea of the magnitude of the forces and couples that might be applied to an aircraft without infringing some arbitrary limit of comfort, some tests were carried out on the physiological effect of vibration of different frequencies. As a result of these tests limiting values for the magnitudes of most sources of vibration were defined. These limits were found to depend on the frequency of the vibration. Their lowest values occurred at a frequency between 1,000 and 1,400 per minute, and limited the forcing impulses to 50 lb. and 1,200 lb. in. for a force and couple respectively, in an aircraft of 4,000- to 5,000-lb. total weight.

The actual sources of vibration existing in aircraft were then considered; the magnitude of these sources were compared with the limits already laid down. As a result of this comparison it became possible to say which sources were the principal cause of unpleasant vibration. It was found that, whereas the engine primary unbalance was insufficient to cause serious vibration, the engine secondary unbalance might do so when the specific unbalance was large. Of the harmonics of the engine torque reaction, those of half-order and first order were the only ones of importance. Normally neither of these were responsible for serious vibration, but either or both might be accentuated by a derangement of engine tune or by faulty distribution or ignition.

The chief source of airscrew vibration was the effect of cross-wind on the blades of the airscrew. When on the turn, or when climbing with large incidence, this source of vibration might become very serious. Other sources of airscrew vibration were gyroscopic couples on the airscrew blades when turning, and airscrew static and dynamic unbalance under all conditions of flight.

During the consideration of a number of specific problems it was pointed out that vibration was greatly reduced as a result of replacing a two-blade by a four-blade airscrew, and the reasons for this were discussed. The increased tendency of a geared engine to vibrate was attributed, not so much to the increase in magnitude of any of the sources of vibration, as to the lowering toward the conditions of resonance of the frequency of the forcing impulses due to the airscrew. The stresses imposed on the structure due to vibration were found to be usually small; but in cases where the vibration greatly exceeded the limits of unpleasantness, the stresses might assume serious proportions.

In conclusion, it is considered that by various means most instances of serious vibration can be cured, but the cost of this cure, whether in airscrew or engine efficiency, may, in some instances, be greater than is justified by the increasing comfort of the aircraft.

Airisms from the Four Winds

A Dinner to Miss Salaman

A DINNER to Miss Peggy Salaman, who, with Mr. Gordon Store, recently broke the record from England to Capetown, is being organised by the Air League of the British Empire to take place on December 2 at the Dorchester Hotel. At the time of going to Press details of the arrangements are not available, but it is anticipated that it will be held under distinguished patronage, and that the gathering will be truly representative of British Aviation, in order that Miss Salaman may receive the congratulations which she justly deserves. Full details can be obtained from Capt. A. J. Barlow, Air League of the British Empire, Astor House, Aldwych, London, W.C.2. Mr. Store, it should be noted, is remaining in South Africa for the present.

Sir Alfred Yarrow's Air Tour

SIR ALFRED YARROW, the well-known Glasgow shipbuilder, accompanied by his secretary, left Croydon on November 15 in an Imperial Airways machine, piloted by Capt. Olley, on an aerial tour of Europe. Sir Alfred will be 90 next January.

The Authors' Club Becomes Airminded

THE Authors' Club held a Dinner on Monday, November 23, at which the chief guests were well-known personalities in the aviation world, and the topics of discussion were aerial matters. Mr. Justice Bullock was the Chairman, while Major Jones occupied the Vice-Chair. Among those who took part in the discussion were Air Marshal Sir Robert Brooke-Popham, Mr. C. R. Fairey, Com. Lloyd Owen, Flt. Lt. N. Comper and Dr. A. P. Thurston. A Christmas Dinner will be held on December 7, when Mr. H. de Vere Stacpoole will preside and Lord Wakefield will be the club guest.

Rolls-Royce Engines for Japanese Aircraft?

THE ROLLS-ROYCE COMPANY have received an urgent cable from their agents in Japan asking them what is the earliest possible date they can commence deliveries of 825-h.p. aircraft engines. It is understood that the engines are to be installed in giant flying-boats for the Japanese Navy. The flying-boats are now being built in Japan from the pattern of Short Bros., the famous aircraft manufacturers of Rochester (Kent). The first flying-boat of this type was delivered to the Japanese Navy last year by Short Bros. The Japanese acquired the right to build these boats and they are made in Japan under the direction of a group of workmen from Rochester. The flying-boats are all fitted with three Rolls-Royce "Buzzard" engines and are on the Japanese secret list. Although details concerning them may not be published, it is believed that they are the most remarkable machines of the type that have ever been built. The "Buzzard" is a development of the supercharged "Kestrel" engines fitted to the Hawker "Furies," the fastest interceptor fighters in the world. Commenting on this urgent inquiry from Japan, Mr. A. F. Sidgreaves, Managing Director of Rolls-Royce, said: "Although the aircraft would be built in Japan, the engines would be produced entirely in Derby. We have already supplied engines of this type for the Japanese Navy which have given complete satisfaction. I believe that the flying-boats built in Japan are a great advance in aircraft construction and have a wonderful performance."

The "Akron's" Telephone System

NINETEEN telephones, a telephone exchange, and three miles of wiring are carried by the American airship *Akron*, which has just been completed. As lightness was one of the essentials to be considered in designing the system, aluminium was used wherever possible, and the whole telephone outfit, exchange and all, weighs only 250 lb. The nineteen telephones are located at strategic points. Two are provided for the observation and gun platforms on the top of the airship, two for the engine room, and three for the gangway leading from the officers' quarters above the control room to the bow. Gangways extend along each side of the ship, providing access to quarters, the aeroplane compartment and engine rooms, and a number of telephones are to be found in these gangways. The captain of the *Akron* is able not only to talk to any single telephone, but to talk to all nineteen at once. He can also establish communication between the airship and the telephone service on land by means of a line leading through the nose of the ship to the mooring mast. The *Akron* is 785 ft. long, and is equipped with eight 560-h.p. engines. Its top speed is 83 miles an hour and its capacity is 1,000,000 cub. ft. greater than that of the late British R 100.

Private Secretary to Sir Philip Sassoon

THE RT. HON. SIR PHILIP SASSOON, Under-Secretary of State for Air, has appointed Mr. T. L. E. B. Guinness, M.P., to be his Parliamentary private secretary.

Air Mail Pilot Raises Fire Alarm

FOR the fifth time in three years, Lewis Gravis, a mail pilot of United Air Lines, sounded his "plane fire alarm" recently to save the lives of sleeping people in a burning house. Flying the night mail from Kansas City to Chicago, he noticed a dwelling ablaze and circled it with his Hornet motor wide open, remaining in the vicinity until he saw the occupants escape through the windows.

Clover Sowing from Aircraft

A CONTRACT for sowing clover seed on 4,000 acres of stock range near Maxwell (Calif.) has been undertaken by aeroplane. The seeding is an experiment in the utility of aircraft for this purpose which is being watched closely by stockmen in the valley, and if successful will open a new field of industrial use for planes.

Schneider History in Lantern Slides

A SPECIAL series has just been added to FLIGHT collection of lantern slides, namely, a selection depicting the history of the Schneider Trophy Contest, from first to last. This, and any of the other series of FLIGHT lantern slides can be loaned to those wishing to deliver lectures, etc., on application to FLIGHT offices. It is advisable, however, when applying for the slides, to give several days' notice in case they are already in use. Also, slides should be returned as soon after the lecture as possible.

California's Licensed Aircraft

CALIFORNIA tops the list with the greatest number of licensed aircraft in the United States with 3,092. New York has 1,658 and Illinois 1,301. California also leads in the number of licensed air mechanics.

THE RECORD BREAKERS: Miss Peggy Salaman and Mr. Gordon Store taken on their arrival at Cape Town on November 5, when they beat the record for the England–Cape flight, with 5 days 6 hours 40 minutes, in the D.H. Puss Moth "Good Hope."

CORRESPONDENCE

The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns.

R 100

[2779] I have just read in the daily Press that R.100 is now definitely sold, and is to be broken up for "scrap" (apart from the engine, which remains in the Government's keeping).

May I suggest that some air-minded person buys the navigational and other instruments and presents them to, say, the Royal Aeronautical Society, that is, if the said Society has not already thought of taking this step. It would at any rate keep part of R.100 "in the family," so to speak, instead of letting them go to someone who would only regard them as curiosities, instead of looking upon them as emblems of what has been and of *what might yet be*. The only remark one can make on the dismantling of Great Britain's sole remaining airship is "*A Dios . . . Quién sabe?*"

I only regret that I myself am unable to carry out the above suggestion, which, should it come to pass, I hope will be appreciated by all sometime airship officers and crews. Hail and farewell, R.100!

Wembley Park, Middlesex. MARY KNIGHTLEY.
November 17, 1931.

POBJOY ENGINE PARTS

[2780] May I be permitted to reply to the letter published in this week's issue of FLIGHT, from Mr. T. A. Dennis, of Messrs. A.B.C. Motors, Ltd., with reference to "Pobjoy Engine Parts." In order that the claims made by Mr. T. A. Dennis may thoroughly be assessed by your readers, I feel that an explanation from The Mollart Engineering Co. is necessary, so that the actual position may be gauged.

The first 45 cylinder barrels, including those for the all-important type-test engine (which came through with flying colours) were completely machined throughout from the forgings (not castings as stated by Mr. Dennis) by my company. In order to increase the output of Pobjoy engine components, and to facilitate the design and manufacture of the crankcase jigs, fixtures and gauges which we had on hand, we agreed to Messrs. A.B.C. Motors, Ltd., doing certain machining operations on the cylinder barrels (as a temporary measure) which are as follow:—Turn, screw, and form outside, and bore the cylinder barrels.

We then completed the machining operations, which are as follow:—Rough and finish hone all bores, screw the cylinder barrel on to the head (using the Pobjoy patent clamping ring), drill and spot face bolt holes, machine square flange on cylinder barrel foot, mill rod clearances, drill and ream holes for valve rocker brackets.

I feel all engineers will be able to assess the relative importance of the operations carried out by Messrs. A.B.C. Motors, Ltd., and my company respectively, and whilst not wishing in any way to detract from the good work carried out by my friend Mr. T. A. Dennis, I feel that neither your mention of my company's name under the heading of "Butler's Flight to Australia," nor our paid advertisement, overstated our claim, and in conclusive proof of the above I quote the designer's opinion when he writes as follows:—

11th June, 1931.—"We should like to express our appreciation of the exceptional good finish and accuracy of the various parts you have supplied us for our aero engines.

"We feel confident that the remarkable power output obtained from these engines without prolonged running in, the freedom from gas leaks and cylinder distortion, and the low oil consumption of the engines, may be entirely attributed to the accuracy and precision with which the cylinder bores are finished, the valve seats inserted in the heads and the heads screwed on the barrels.

"The accuracy of the pistons also contributed to the gratifying results."

This testimonial from Mr. Pobjoy, who has proved himself one of our leading aero-engine designers, definitely "Renders unto Cæsar that which is Cæsar's," and can be seen at any time at our works.

THE MOLLART ENGINEERING CO.,
Thames Ditton, Surrey. A. J. MOLLART.
November 21, 1931.

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R.A.F. RUGBY FOOTBALL

Cranwell *versus* Royal Military Academy, Woolwich

(From a Correspondent)

Result:—Cranwell 14, Woolwich, 5

ON Saturday, November 14, the Royal Air Force College played the Royal Military Academy at Cranwell. The result of this match was expected with some interest, as Cranwell the previous week suffered defeat at the hands of Sandhurst, whom Woolwich have yet to play.

The game was played under good conditions, the turf being firm. There was no sun and only a moderate wind. A great number of spectators assembled and followed every movement of an open and exciting game.

The game opened with some very fast work among the Woolwich threes. It was clear that they were a good deal faster than their opponents. Also, their forwards were heavier and were cleverer at getting the ball back to Lewin, who played a skilful game at the base of the scrum. But the handling of the Woolwich wings was their weak point; and this, combined with the better tackling of Cranwell, who had taken to heart the lessons of the Sandhurst match of a week before, kept the score down. But after about twenty minutes' play the Woolwich attack would not be denied. They again got the ball cleanly out, passed it along their line of threes, and Winchester, their captain, getting well into position, took a pass and scored near the posts. The try was converted. This was to be the only Woolwich score.

Cranwell, who had for various reasons turned out a team which was largely experimental, now got together, and gradually assumed the offensive, though the score remained unaltered at half-time.

After half-time, Cranwell playing with the wind, continued their attack, and never dropped it till the end of the game. A few minutes after the start, Collyns, a flight cadet from New Zealand, who played a fine winging game throughout, and who should get into first-class football, scored far out a try which was not converted. Cranwell were soon on the attack again. From a line-out Prowse got the ball and carried it deeply into the Woolwich 25 till he was brought down by Sykes, the Woolwich full back, who played a gallant game throughout. Then Golding, a versatile player, who represented the Public Schools at scrum half before he came to Cranwell, after a long bout of individual dribbling, picked up cleverly, and ran in under the Woolwich posts for a try, which again was unconverted. A few minutes later Prowse, from a cross kick by Doran, scored again for Cranwell. The score was now 9—5 in favour of Cranwell, a dangerous score, for Woolwich had only to score a goal to be one point ahead. The old moral about the importance of place kicking is obvious. However, Cranwell consolidated their position despite a desperate Woolwich offensive, when Parselle ran over with a clever swerve on the blind side of the scrum. About this kick Elsner made no mistake. There was no relaxation by either side during the last keen minutes of the game, but also no further score; thus Cranwell were left the victors by 14 points (3 tries and a goal) to 5 (a goal). For Cranwell, Elsner and Leigh were outstanding, the latter playing with great courage and determination. Of the forwards, Collyns and Rhys were probably best. Of the "shop" team, Winchester, their captain, led his forwards pluckily, Sykes was reliable at full back, and Lewin was very clever behind the scrum.

The thanks of both sides are due to the exemplary refereeing of Mr. Bott.

THE ROYAL AIR FORCE

London Gazette, November 17, 1931.

General Duties Branch

Pilot Officer on probation D. H. Marsack is confirmed in rank (Oct. 6). The follg. Pilot Officers are promoted to rank of Flying Officer:—D. J. Alvey (July 14); A. C. D. Webb (Sept. 28); D. W. Morrish (Oct. 13); R. W. H. Rayneau (Oct. 17); R. M. Smith (Oct. 22); A. W. S. Matheson (Oct. 28).

Squadron Leader L. G. S. Payne, M.C., A.F.C., half-pay list, Scale B, is transferred to Scale A, with effect from November 1; Lieut. G. R. Maw, R.N., Flying Officer, R.A.F., relinquishes his temp. commn. on return to Naval duty (Nov. 15).

Stores Branch

Flight-Lieut. J. McCarthy is placed on retired list (Nov. 14).

Medical Branch

Flight-Lieut. T. J. D. Atteridge, M.R.C.S., L.R.C.P., is promoted to rank of Squadron Leader (Nov. 16).

Dental Branch

Flying Officer C. M. Leckie, L.D.S., relinquishes his temp. commn. on completion of service (Oct. 18).

Memorandum

317719 Flight Cadet J. May is granted an hon. commn., as Sec. Lt., with effect from date of demobilisation.

ROYAL AIR FORCE RESERVE
RESERVE OF AIR FORCE OFFICERS

General Duties Branch

J. A. Rogers is granted a commn. in Class AA (i) as a Pilot Officer on probation (Sept. 17). The follg. Flying Officers are transferred from Class A to Class C:—C. O. Meeke (June 19); S. H. Cooper (July 4). Flying Officer W. G. Gunning is transferred from Class B to Class C (Aug. 27).

The follg. Flight-Lieuts. relinquish their commns. on completion of service: T. Rose, D.F.C. (Sept. 12, 1930); R. T. Nevill (Aug. 25). The follg. Flying Officers relinquish their commns. on completion of service:—C. E. F. Riley (Jan. 11); R. H. Winn (Aug. 10); L. E. Maynard (Sept. 2); E. C. Roark (Sept. 9).

Flight-Lieut. G. R. Hicks, D.F.C., relinquishes his commn. on completion of service and is permitted to retain his rank (July 1); Flying Officer H. D. Wardle relinquishes his commn. on completion of service and is permitted to retain his rank (Aug. 18).

Stores Branch

Squadron Leader G. E. Stagg, M.B.E., relinquishes his commn. on completion of service and is permitted to retain his rank (June 17).

SPECIAL RESERVE

General Duties Branch

Flight-Lieutenant R. C. Preston, A.F.C., resigns his commn. (April 20).

AUXILIARY AIR FORCE

General Duties Branch

No. 600 (CITY OF LONDON) (BOMBER) SQUADRON.—Pilot Officer I. R. Campbell-Orde to be Flying Officer (June 10).

No. 601 (COUNTY OF LONDON) (BOMBER) SQUADRON.—Flight-Lieut. S. B. Collett to be Squadron Leader and to command the Squadron (Sept. 3).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Group Captains: W. C. Hicks, A.F.C., to Home Aircraft Depot, Henlow, pending taking over command, 9.11.31. J. S. T. Bradley, O.B.E., to H.Q., Wessex Bombing Area, Andover, pending appointment as Senior Air Staff, Officer 8.11.31.

Wing Commanders: C. C. Miles, M.C., to H.Q., R.A.F., Mediterranean, Malta, for Air Staff duties, 7.11.31. J. C. Russell, D.S.O., to H.Q., R.A.F., Transjordan and Palestine, Jerusalem, for Air Staff Duties, 19.10.31. E. L. Tomkinson, D.S.O., A.F.C., to R.A.F. Depot, Uxbridge, 4.11.31.

Squadron Leaders: C. R. Cox, A.F.C., to Air Ministry (D. of P.), 8.11.31. F. H. Laurence, M.C., to Armament and Gunnery School, Eastchurch, 29.10.31. C. Boumphrey. D.F.C., to R.A.F. Depot, Uxbridge, 25.9.31. A. L. Fiddament, D.F.C., to No. 17 Sqdn., Upavon, 31.10.31. G. S. Oddie, D.F.C., A.F.C., to No. 3 Flying Training School, Grantham, 1.11.31. V. S. E. Lindop, to Special Duty List, whilst employed with the Abyssinian-Somaliland Boundary Survey Commission, 25.10.31. J. W. Jones, to No. 13 Sqdn., Netheravon, 9.11.31. O. C. Bryson, M.C., D.F.C., A.M., to R.A.F. Depot, Uxbridge, 17.10.31. J. A. Sadler, to School of Naval Co-operation, Lee-on-Solent, 14.10.31.

Flight Lieutenants: R. R. Greenlaw, M.B.E., to No. 24 Sqdn., Northolt, 10.11.31. M. D. Ommanney, to No. 33 Sqdn., Bicester, 8.11.31. A. W. Franklyn, M.C., to Station H.Q., Andover, 1.11.31. E. D. MacL. Hopkins and C. M. Heard, to Armament and Gunnery School, Eastchurch, 1.11.31. W. J. Millen, to R.A.F. Depot, Uxbridge, 3.11.31. D. F. Anderson, D.F.C., A.F.C., to No. 27 Sqdn., Kohat, India, 24.10.31. W. Elliot, D.F.C., to No. 101 Sqdn., Andover, 7.11.31.

Flying Officers: J. R. Whitley, to No. 101 Sqdn., Andover, 2.11.31. T. M. Abraham, and G. E. F. Proctor, to Armament and Gunnery School, Eastchurch, 1.11.31. H. R. Collins, to No. 13 Sqdn., Netheravon, 1.11.31. D. C. Harrison, to No. 2 Sqdn., Manston, 1.11.31. E. C. Bates, to No. 57 Sqdn., Netheravon, 12.11.31. N. D. Lamb, to Aircraft Park, Lahore, India, 30.10.31. C. P. Barker, to Station H.Q., Hal Far, Malta, 29.10.31. M. G. Parker, to No. 20 Sqdn., Peshawar, India, 15.10.31. D. H. A Golege-Steel, to No. 20 Sqdn., Peshawar, India, 25.10.31. E. W. Downing, to Anti-Aircraft Co-operation Flight, Biggin Hill, 22.10.31. A. H. Houghton, to School of Army Co-operation, Old Sarum, 16.11.31. G. Bearne, to No. 33 Sqdn., Bicester, 16.11.31. N. J. Capper, to No. 12 Sqdn., Andover, 16.11.31. F. C. Allen and A. W. B. Page, to No. 58 Sqdn., Worthy Down, 16.11.31. W. E. Grant and G. R. Stroud, to No. 99 Sqdn., Upper Heyford, 16.11.31. R. L. West, to No. 7 Sqdn., Worthy Down, 16.11.31. G. E. Mustard, E. Poole, J. F. Sutton, E. Elgey, R. G. E. Catt, all to No. 502 Sqdn., Aldergrove, Northern Ireland, 9.11.31. C. P. F. Alderson, R. P. J. Leborgne, M. P. Price, D. M. T. Macdonald, all to No. 503 Sqdn., Lincoln 9.11.31. V. A. Dawson and D. W. Lucke, to No. 504 sqdn., Nottingham, 9.11.31.

Pilot Officers: B. A. Casey, W. Pickersgill and H. L. Tancred, to No. 70 Sqdn., Hinaidi, Iraq, 16.10.31. J. J. A. Ellison, to R.A.F. Depot, Uxbridge, 29.9.31.

Stores Branch

Squadron Leader L. A. Lavender, to Home Aircraft Depot, Henlow, 9.11.31.
Flight Lieutenants: J. J. Ironmonger, to Air Ministry (D. of E.), 9.11.31. A. J. Redman, D.F.C., to H.Q., R.A.F., India, Delhi, 30.10.31. *Flying Officer* W. G. S. Wood, to No. 20 Sqdn., Peshawar, India, 15.10.31.

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AIR MINISTRY NOTICES

NOTICE TO GROUND ENGINEERS

No. 63 of the year 1931. Fuel System: Tanks. (1238624/31.)

Attention is drawn to the fact that paragraph 6 (ii), Design Leaflet D. 3, Air Publication 1208 has been amended to read as given below.

The requirements of this paragraph, as amended, will be brought into effect in respect of all applications for Certificates of Airworthiness, as follows:—

(*a*) Applications for Type Certificates of Airworthiness after the 1st May, 1932.

(*b*) Applications for subsequent Certificates of Airworthiness after 1st January, 1932.

(*c*) Applications for renewals of Certificates of Airworthiness after 1st March, 1932.

The requirements of paragraph 6 (ii), Design Leaflet D. 3, Air Publication 1208, are now as follows:—

(ii) The fuel supply from all tanks must be such that it is not affected by the collection of foreign matter in the tank, and all tanks must be provided with readily accessible means for draining away all accumulations of water and other foreign matter.

(November 14, 1931.)

No. 64 of the year 1931. Expansion of Exhaust Pipes. (138094/31.)

When exhaust tail pipes are fitted, arrangements are to be made to relieve the exhaust manifolds or exhaust rings and their attachments of any stresses set up by the expansion of the tail pipes.

The above requirements will not be applied retrospectively, but must be satisfied by all new type aeroplanes for which application for a Certificate of Airworthiness is made after January 1, 1932.

(November 14, 1931.)

No. 65 of the year 1931. Requirements Relating to Electrical Installations on Flying Machines (excluding special installation requirements for wireless apparatus and ignition systems). (83525/31.)

The attention of aircraft owners and ground engineers is drawn to the fact that the requirements of Design Leaflet E.2, Air Publication, 1208, Airworthiness Handbook for Civil Aircraft, will be brought into effect:—

(*a*) On 1st January, 1932, in the case of aircraft in respect of which original certificates of Airworthiness are issued on and after that date.

(*b*) From 1st January, 1932, in the case of aircraft in respect of which application is made on or after that date for renewal of an existing Certificate of Airworthiness.

This Design Leaflet sets out the requirements relating to:—Cables, compasses, wiring, generators, voltage regulators, battery cut-outs, accumulators, switches, fuses, navigation lights, landing and other flares, accessories, tests.

(November 16, 1931.)

No. 66 of the year 1931. Requirements Relating to the Installation of Wireless Apparatus in Flying Machines. (83525/31.)

The Air Navigation Directions, 1930, Section IX, prescribe that "Every British aircraft registered in Great Britain and Northern Ireland and capable of carrying 10 or more persons including the crew, shall, when carrying passengers or goods for hire or reward, carry apparatus for wireless telegraphy capable of sending and receiving morse or spoken messages by wireless telegraphy, which is of a type approved by the Secretary of State, and the installation of which (including bonding and screening) is in accordance with requirements laid down by him."

In accordance with these Directions, requirements in respect of the installation of wireless apparatus have been prepared for incorporation in Design Leaflet E.5, Air Publication 1208, Airworthiness Handbook for Civil Aircraft, and will be brought into effect as follows:—

(*a*) On 1st January, 1932, in the case of aircraft in respect of which original Certificates of Airworthiness are issued on or after that date.

(*b*) From 1st January, 1932, in the case of aircraft in respect of which application is made on or after that date for renewal of an existing Certificate of Airworthiness.

(November 16, 1931.)

No. 67 of the year 1931. Requirements Relating to Wireless Apparatus for Use in Flying Machines. (83525/31.)

The requirements in respect of wireless apparatus for use in aircraft have been prepared for incorporation in Design Leaflet E.4, Air Publication 1208, Airworthiness Handbook for Civil Aircraft, and will be brought into effect in respect of all applications for Certificates of Airworthiness (*i.e.*, applications for type Certificates, applications for subsequent Certificates, and applications for renewals of Certificates) as from November 16, 1931.

(November 16, 1931.)

AIRCRAFT COMPANIES' STOCKS AND SHARES

THE market for industrial shares has lost some of its buoyancy, and the tendency has been for quotations to move slightly against holders. This is not attributed by dealers to any heavy selling but to a falling off in demand, which has been in evidence despite the resumption of account dealings by the removal of the "cash only" restriction on dealings. Both professional operators and the public appear to be adopting a waiting attitude for the time being, pending reassuring news regarding the German financial position and its possible repercussions here. The Anti-Dumping Act and the immediate issue of the first order under this measure has kept interest mainly centred on the shares of companies likely to benefit from a tariff policy. The shares of aircraft and allied companies have practically maintained their recent improvement. Imperial Airways have been a good feature, with a rise on the month from 13s. 6d. to 16s. This reflects a wider recognition that improvement in general trade conditions should react favourably on the company, and also attention drawn to the new Cape route. The tendency has always been for prospects to enter a good deal more into the valuation of these shares than immediate dividend yield. At one time this year over 17s. was touched, and the highest price recorded in 1930 was more than 30s. Fairey Aviation have changed hands up to well over 15s. during the month, and remain a steady market on hopes that the forthcoming report will show a further increase in profits. De Havilland have improved and have been done up to 18s. 3d. on the hope that in this case the report will disclose recovery from the previous year's set-back in profits. The quotation has risen from 16s. 3d. to 17s. 9d. on the month. D. Napier & Sons were also better, partly on the view that, although the interim dividend has been passed, the dividend for the year is at least likely to show a satisfactory return on the shares at around their present price. It now transpires that Rolls-Royce has been successful in securing control of Bentley Motors. Rolls-Royce are 33s. 4½d., or the same as a month ago. Petters remained at 20s. National Flying Services have marked 3¼d. and 4d.; at the time of writing the report has not been published, but it is due any time now. Handley Page have again moved slightly in favour of holders and are now 11s. 3d. In other directions, "Shell" are only a few shillings lower on the month, despite the passing of the interim dividend; the directors' statement, which emphasised the inherent strength of the company, created a favourable impression. Joseph Lucas have come in for further support, on the view that provided trade conditions show sustained improvement there seem reasonably good prospects of the distribution for the current year returning to 25 per cent. S. Smith & Sons' issues have also come in for some support, and have been marked up sharply on dividend hopes. It may be recalled that the interim dividend on the preferred ordinary shares was lowered from 5 to 2½ per cent. Interim dividends are not paid on the deferred shares. The report is due to be published in December. Triplex Glass have continued in demand and show a further rise for the month; favourable reports are current regarding the company's business. Brown Brothers have moved in favour of holders. Vickers held most of their rise, and Kayser Ellison and several other issues have been marked up partly on tariff possibilities. Birmingham Aluminium Casting were better despite the lowering of the dividend from 7½ to 5 per cent. Net profits come out at £15,488, as against £25,266 for the previous year. There has been a good deal of speculative activity in British Celanese on indications of improving conditions in the rayon industry; the price has been marked up during the month from 4s. to over 12s. The improvement in British Thomson-Houston preference reflects the repayment of the company's 7 per cent. debentures, which has added further to the status of these preference shares. Dunlop Rubber are higher on the month at 17s.

Name.	Class.	Nominal Amount of Share.	Last Annual Dividend.	Current Week's Quotation
			%	
Anglo-American Oil	Deb.	Stk.	5½	99
Armstrong Siddeley Develop ..	Cum. Pref.	£1	6½	14/4½
Birmingham Aluminium Castg.	Ord.	£1	5	18/6
Booth (James), 1915	Ord.	£1	15	39/9
Do. do.	Cum. Pref.	£1	7	22/6
British Aluminium	Ord.	£1	10	27/9
Do. do.	Cum. Pref.	£1	6	18/9
British Celanese	Ord.	10/-	Nil	12/7½
British Oxygen	Ord.	£1	8B	18/1½
Do. do.	Cum. Pref.	£1	6½	18/9
British Piston Ring	Ord.	£1	10	25/-
British Thomson-Houston ..	Cum. Pref.	£1	7	24/-
Brown Brothers	Ord.	£1	10	23/9
Do. do.	Cum. Pref.	£1	7½	21/3
Dick (W. B.)	Cum. Pref.	£10	5	116/3
De Havilland Aircraft	Ord.	£1	5	17/9
Dunlop Rubber	Ord.	C	6	17/-
Do. do.	"C" Cum. Pref.	16/-	10	15/-
En-Tout-Cas (System)	Def. Ord.	1/-	Nil	1/-
Do. do.	Ptg. Pfd. Ord.	5/-	8	3/1½
Fairey Aviation	Ord.	10/-	7*	15/-
Do. do.	1st Mt. Deb.	Stk.	8	105
Firth (T.) & John Brown ..	Cum. Pref.	£1	6D	9/-
Do. do.	Cum. Pref.	£1	5*D	8/6
Ford Motor (England)	Ord.	£1	10	39/4½
Fox (Samuel)	Mt. Ptual. Deb.	Stk.	5	72½
Goodyear Tyre & Rubber ..	Deb.	Stk.	6½	99½
Handley Page	Ptg. Pref.	8/-	12½	11/3
Hoffmann Manufacturing ..	Ord.	£1	Nil	16/3
Do. do. ..	Cum. Pref.	£1	7½	15/-
Imperial Airways	Ord.	£1	3	16/-
Kayser, Ellison	Ord.	£5	Nil	57/6
Do. do.	Cum. Pref.	£5	6	77/6
Lucas (Joseph)	Ord.	£1	20	68/9
Napier (D.), & Son	Ord.	5/-	15	5/9
Do. do.	Cum. Pref.	£1	7½	20/7½
Do. do.	Pref.	£1	8	17/6
National Flying Services ..	Ord.	2/-	Nil	-/4½
Petters	Ord.	£1	6	20/-
Do.	Cum. Pref.	£1	7½	18/9
Roe (A. V.) (Cont. by Armstrong-Siddeley Devel., *q.v.*)	Ord.	£1	—	—
Rolls-Royce	Ord.	£1	10	34/4½
Smith (S.) & Sons (M.A.) ..	Def. Ord.	1/-	18¾	2/3
Do. do. ..	Ptg. Pfd. Ord.	£1	12½	17/6
Do. do.	Cum. Pref.	£1	7½	17/6
Serck Radiators	Ord.	£1	15	31/-
"Shell" Transport & Trading ..	Ord.	£1	17½*	38/1½
Do. do.	Cum. Pref.	£10	5	£9
Triplex Safety Glass	Ord.	£1	10	33/9
Vickers	Ord.	6/8	8	9/3
Do.	Cum. Pref.	£1	5*	19/-
Vickers Aviation (Cont. by Vickers, *q.v.*)	—	—	—	—
Westland Aircraft (Branch of Petters, *q.v.*)	—	—	—	—
Whitehall Electric Investmts.	Cum. Pref.	£1	7½	23/-

*Dividend paid tax free. B Rate per annum for nine months.
C £1 unit of stock. D Last xd. on March 19.

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: Cyl. = cylinder; i.c. = internal combustion; m. = motors. (The numbers in brackets are those under which the Specification will be printed and abridged, etc.).

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Published November 26, 1931

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